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FUNDAMENTAL SKILLS NEEDS ASSESSMENT METHODS

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The present research was conducted in recognition of a growing nationwide shortfall in fundamental job skills, and the potential that this shortfall has for impacting the ability of the Air Force (AF) to carry out its mission. Future projections reflect the dilemma of a growth in the demand for specialized skills training at a time when a large proportion of the labor market is not expected to have the more fundamental enabling skills required to successfully complete the training.

Section I provides background information regarding the AF Fundamental Skills project. Section II is a discussion of the concept of "fundamental skills." It includes a set of criteria for defining this concept. Section III is a discussion of conceptual approaches used for defining fundamental skills. Atheoretical and theoretical approaches are reviewed. Fundamental skills data collection and analysis methods are discussed in Section IV. The authors recommend job analysis as the best approach to identifying fundamental skills. An evaluation of job analysis methods for AF use is provided in Section V. The General Work Inventory (GWI) emerges as the preferred job analysis technique based on the evaluation criteria proposed. This report concludes with a set of recommendations for continued research in AF related fundamental skills.

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PREFACE

Fundamental Skills Needs Assessment Methods was sponsored by HQ USAF/DPXA and AL/HRTE under Contract Number F49650-86-D5003 (Delivery Order Number 5024).

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SUMMARY

A number of changes in the U.S. workplace and job market are expected between now and the year 2000, both in the characteristics of the available labor applicants and the nature of available jobs. These future projections reflect the dilemma of a growth in the demand for specialized skills training at a time when a large proportion of the labor market is not expected to have the more fundamental enabling skills required to successfully complete the training.

Thus, the ability to recruit, train and effectively utilize 18-22 year olds with fundamental skills deficiencies will put the Air Force at a distinct advantage in fulfilling its mission. However, to accomplish this goal, necessary first steps include defining "fundamental skills" in a manner which is consistent with some verifiable framework or conceptual orientation which has utility for Air Force applications; identifying and evaluating methods to assess fundamental skills requirements in the Air Force; and identifying methods for linking the assessment methods both within the Air Force occupational levels and to the population of future applicants. These were our top-level objectives in conducting the research.

We proposed six criteria to be used in defining fundamental skills for AF training purposes. Using these criteria, skills which are most likely to be considered fundamental are those which can be reliably measured, enable the learning of more technical, job-specific information, and are relatively free of explicit occupational content. Our review of the literature revealed that different scientific perspectives or orientations effect the identification and definition of skills. However, all current orientations agree upon the importance of considering the individuals environmental context when attempting to define or modify fundamental skills.

The identification of fundamental skill requirements must be based on understanding of the nature and requirements of the Air Force work context. Thus, after a review of a variety of job analysis methods, we recommended the use of a worker-oriented structured questionnaire. We further evaluated a number of job analysis tools and techniques of data collection. This evaluation revealed that the General Work Inventory (GWI) is well suited for a fundamental skills needs analysis survey at both the career field and specialty levels. An alternative approach, which entails an intensive analysis of enabling skills for success in training, was also suggested.

I. INTRODUCTION

Background

The present research is being conducted in recognition of a growing nationwide shortfall in fundamental job skills, and the potential that this shortfall has for impacting the ability of the Air Force (AF) to carry out its mission. Varying estimates are available as to the magnitude of the fundamental job skills problem in this country. Statistics noted below are among the more frequently cited:

1. According to the U.S. Census Bureau, 13% of U.S. adults (or approximately 27 million people) are illiterate, and another 20% (or approximately 5 million people) can perform only minimal reading and writing. Moreover, the number of functionally illiterate people in the U.S. increases by 2.3 million annually (Jakubovics, 1986).

2. According to the U.S. Department of Education, large majorities of today's 17 year-olds (81% to 96%) have only rudimentary interpretative skills. They can make generalizations, solve one-step problems, and understand basic science. However, only 5% to 8% of these people demonstrate skills typically associated with more demanding jobs or college work (Mullis, Owen, & Phillips, 1990).

3. There is a large nationwide population of "intermediate literates" who only have a fourth to eighth grade literacy equivalency (although many are high school graduates) and who have not obtained a functional or employable literacy level. This group will make up as much as 65% of the entry-level workforce over the next 15 years (Semerad, 1987).

4. As many as 75% of large U.S. corporations offer some type of basic skills training (Lee, 1988).

The Hudson Institute, in their widely circulated report, Workforce 2000, commented that: "Very few new jobs will be created for those who cannot read, follow directions, and use mathematics." American managers agree with this summarization, and have openly expressed fear that the pool of talent needed to fulfill this minimal literacy requirement is running low. In the Fall of 1990, six Fortune 500 companies underwrote a 12-page ad in Time Magazine, warning of "the disappearing quality of the U.S. workforce." Academic scholars are in agreement with the business community on this issue. This same weakening in the academic talent of the workforce may impact on the Air Force's recruitment needs as well. If the average high school graduates today possesses only a portion of the quantitative and verbal comprehensive skills of the graduates of twenty years ago, then the gap must be closed through better selection testing, or through training once they are recruited.

The Air Force and the other military services have long been aware of this growing literacy problem, and have sponsored several research and development programs aimed at addressing skill deficiency issues. Madden and Tupes (1966) found a strong correlation between the General Aptitude Index used in the classification of AF enlistees and two commercial reading tests. On the basis of this relationship, a conversion table was developed which equated General Aptitude Index percentiles to Reading Grade Levels (RGLs) for the California Achievement Test reading section. An RGL of 9.0 was found to be equivalent to a General Aptitude Index of the 45th percentile. This General Aptitude Index was later implemented as a selection measure to provide a minimum level of literacy among AF trainees.

In the early 1970's, the Air Force began to assess the reading requirements of specific occupational areas. Specialty specific written materials (e.g., Technical Orders and training manuals) were analyzed via RGL readability formulas such as the FORECAST and Flesch-Kincaid method (Kincaid & Fishburne, 1977). These formulas typically consider the average length/number of syllables, words, and sentences in written text. The ability to estimate both the RGL of materials used in an occupation and the mean RGL of incumbents of that occupation led to the computation of literacy gaps. Mockovak (1974) reported an early assessment of the match (or mismatch) between required RGLs of various occupational specialties and the estimated mean RGL of enlistees (based on the General Aptitude Index conversion) trained for those specialties. The literacy gap (if any) was defined as the difference between the mean RGL of materials for an occupation and the estimated mean RGL of enlistees assigned to that occupation. A gap of more than two RGLs was considered substantial. Later studies (e.g., Faneuff, 1990) used the AF Reading Abilities Test (AFRAT) (Mathews & Roach, 1983) to measure trainee RGLs. The other services have also examined potential literacy gaps (e.g., McDaniel, Mathews, & Shalow, 1986).

For literacy gaps identified, three countermeasures have been employed. First, attempts have been made to reduce the RGLs of materials. A Military Standard (MIL-STD-1752 (USAF)) was issued in 1978 on target reading level requirements for the preparation of Technical Orders. Second, minimum literacy requirements for military recruits have been increased. This latter countermeasure has been achieved largely through indirect methods. For example, the minimum scores on the Armed Forces Qualification Test (which correlates substantially with reading scores) have been raised. Also, the verbal content of the Armed Forces Qualification Test has been increased (Ree, Mathews, Mullins, & Massey, 1981).

The third countermeasure has been the implementation of remedial literacy training such as the Air Force Basic Military Training (BMT) reading improvement program. In this program, basic recruits who score lower than 9.0 RGL on the AFRAT are placed into a 3-5 day reading program. At the end of their training they must score 9.0 or higher on an alternate form of the AFRAT to continue in the BMT program.

Given the high quality of recent recruits, the potential impact of the fundamental skills problem on the Air Force is debatable. However, the problem should not be ignored. All evidence suggests that fundamental skills deficiencies will reach critical levels over the next decade as the demand for advanced technical skills builds and as the number of new entrants in the workforce declines. Yet, in the face of these types of requirements, estimates provided by the Department of Defense (1982) indicate that the mean reading grade level of the civilian youth population (ages 18 - 23) at large is only 9.4, and it is two to three reading grade levels lower for some minority groups. This situation is particularly troublesome, since minority representation in the primary recruiting pool is expected to grow from 20 to 30 percent by the year 2,000.

While it may be argued that the Air Force can sustain its advantage over the other services in the quality of the recruits it draws, it is not clear that this quality can be sustained continuously at high levels, or levels high enough to satisfy increasing technical demands. The "all-volunteer" approach to securing personnel for our Armed Forces is beginning to face one of its most serious challenges since termination of the draft in 1973. There will be a reduced supply of potential recruits due to a decline in the number of youths in the appropriate age range. At the same time, private sector competition for the most able youth will be stronger than ever, with growing emphasis on increasing the productivity of the workforce to improve the competitiveness of American business. Further, both military and private sector jobs are increasing in complexity as new technologies are adopted. As a consequence of these factors, there is a growing concern over our ability to recruit and train a sufficient number of youths, particularly high ability youths, to ensure the readiness of our Armed Forces.

Federal budget deficits and pressures to support other urgently needed programs are constraining the availability of funds for recruiting and for enlistment incentives that might help alleviate the problems. One possible scenario which the Congress might demand of the DoD is centralized recruitment and allocation of incoming personnel across all the services according to their respective needs. In this scenario, it is reasonable to expect that the Air Force would be required to take an increased proportion of less qualified accessions, and would be faced with workforce fundamental skill deficiencies now being experienced by the other services. Both the Army and the Navy have invested more resources than the Air Force on fundamental skill training programs (reviewed later in this paper) in the past. Under this potential scenario, an equal investment on the part of the Air Force would be required.

Budgetary issues and a lessening of the global threat of war have led to a forecasted downsizing of the military services during the next few years. One approach which will be used to reduce the size of the military will be to restrict the number of accessions, a policy which might lead to an enhanced recruiting environment for high quality personnel. However, this is only one approach to constraining the size of the force's and it does have limitations, as the DoD must

continue to recruit new entrants into the military to maintain a viable force. These continued accessions must come from the youthful population with the changing demographics discussed previously; thus, the basic problem may be smaller in magnitude but, none the less, will still exist. Furthermore, the basic premise that fewer assessions equals higher quality may be faulty.

Another issue arises as a result of downsizing, the potential impact on the morale of the force and continued recruiting success with a "force-out" policy for enlisted personnel. This is a new scenario for enlisted personnel in the services today as they have served in an environment where, given successful performance, they were assured of a full 20 year career. What effect will a change in this policy have on the military's capability to recruit and maintain a quality force? Will it affect the quality of personnel willing to enlist and continue to serve when they no longer have any guarantees of continued service? This change in policy may well effect future recruiting outcomes, and could influence the culture of military service life itself. Downsizing with forced transitions is a new experience for the military, and no one can predict with a great deal of confidence what the eventual total impact will be at this point.

Purpose and Overview

To date, the military has concentrated on literacy training in their basic or fundamental skills training efforts. The Air Force has more specifically focused this type of training on reading skills. While reading skills are important, a major question for the Air Force is what other fundamental skills training should be sponsored? Related questions include what and who should be trained. The Air Force's ultimate objective, as we understand it, in conducting fundamental skills needs analysis research is to gather data relevant to addressing these questions.

However, before addressing these implementation questions directly, there are several conceptual issues and questions which should be considered. These issues include how fundamental skills are defined (e.g., why "fundamental?"), the total range of the skill dimension (e.g., "what skills should be included?"), how is the job related requirement for the training determined (a Congressionally mandated stipulation), and, what are the best training approaches for providing the training? A major objective of this research effort was to review and evaluate concepts and methods which are relevant to addressing these questions. More specifically, this research effort was undertaken with the goal of supporting the following objectives: (a) investigating alternative theoretical orientations for defining fundamental skills, (b) evaluating methods for determining requirements for fundamental skills at varying levels within the Air Force (i.e., career field, specialty level, and possibly job/task level), and (c) addressing the interrelationship among analytic systems supporting these requirements.

It was not a goal of this research to produce a singular list of fundamental skills for AF application. The develpment of such a list must be driven by an analysis of

AF job or training requirements, not a priori reviews of the literature or opinions. Fundamental skills identification will vary according to the different contexts in which the skills are required. It was our intent, however, to describe how different lists of skills have been defined in the past, and how the Air Force might define them for their own use in the future. This objective resulted in the review of a number of different lists and their derivations (described later in this paper). We have also presented a framework for defining fundamental skills and an analytical approach for determining how requirements for these skills can be identified within the Air Force work context.

This report documents the work done in support of the research objectives described in the previous paragraphs and is divided into seven sections. Following this introductory session, we provide a framework for defining fundamental skills and criteria for evaluating the skills for AF application (Section II). We also provide a demonstration of how these criteria can be applied to evaluate the various definitions. In the next section III we review the relevant theoretical orientations and ways of defining fundamental skills published in the literature. As part of this discussion, consideration is given to some broader, interdisplinary approaches, including theory and data from psychology, anthropology, and sociology. Special attention is given to those theories which carry implications for both the definition of fundamental skills, and how these skills are developed.

In the next section (IV), we discuss and evaluate various methodologies and data collection techniques for identifying AF fundamental skill requirements. We also discuss job analysis as the method for determining requirements, and suggest criteria for evaluating the various methods for AF application. In sections V and VI, we evaluate the methods for use at the AF career field and specialty levels of classification, and describe an approach for doing so using a structured questionnaire method. In the last section (VII) we present a summary of our previous discussion in terms of how it relates to AF fundamental skills training, and key conclusions regarding future research efforts.

II. DEFINING THE CONCEPT OF "FUNDAMENTAL SKILLS"

In reviewing the literature on fundamental skills, it does not take long to discover that there is little consensus about how fundamental skills are defined (e.g., Collino, Aderman, & Ascov, 1988). Several classification systems exist to guide instructional developers in defining fundamental skills. These range from older generic skills lists from the 1970's and early 1980's (e.g., Cooney, 1978; Kawula & Smith, 1975; Northcutt, Seltz, Shelton, Nyer, Hickock, & Humble, 1975) to more job-related category systems which tend to emphasize "higher order" thinking skills. However, relatively few have tried to address fundamental skills within a broader conceptual framework (e.g., Resnick, 1987a; 1989). Further, these frameworks have focused on the manner in which fundamental skills training is conducted, not the content of that training.

To provide some feel for the number and types of skills that potentially could be considered "fundamental," and which previous researchers have treated in similar contexts, consider the information presented in Appendix A. This information was drawn from Stasz, McArthur, Lewis & Ramsey (1990), who drew upon related work in the cognitive science, vocational education, training, and workplace literatures. As indicated by Stasz et al., (1990):

> We discovered that not only was terminology diverse, the types of items included under this "generic" umbrella varied greatly. For example, the lists of generic skills were labeled "generalizable skills," "attributes," "talents," "transferable skills," and "occupational adaptability skills." Moreover, the content within lists included basic skills (i.e., math, reading, writing), thinking and problem-solving skills, attitudes and dispositions, creativity, and physical attributes. (p. 59)

Before examining the various conceptual orientations of fundamental skills, one must have a conceptual framework regarding what these skills are, and what they are not. Without this framework, the concept has no boundaries and the investigators are left confused in their search for fundamental skills. Further, issues such as what are skills as opposed to knowledge, abilities, and other personal characteristics, and why a limited number of skills should be considered fundamental while many are not, are difficult to consider without a guiding framework or model. The purpose of this section is to present such a model, and guidelines for defining fundamental skills which can be used to evaluate the various conceptual orientations.

A Conceptual Framework

Skills can be considered a component of the broader taxonomy of competencies which also includes knowledge, abilities, and aptitudes. Knowledge refers to specialized information in a content area. Aptitudes are commonly defined as general competencies, such as verbal or spatial aptitude, which have considerable innate and learned components. Abilities usually are defined as more specific competencies gained through more standardized experiences such as English reading/speaking, or mechanical comprehension. Skills connote demonstrated performance resulting from the application of knowledge and abilities. Thus, knowledge and abilities can be considered the building blocks of skills.

Skill, as used in this paper, will be defined as knowledge and ability manifested in the performance of some task. Anything defined as a skill requirement must be defined in terms of the knowledge (information) and ability factors required for the performance of an activity. Further, skills are not absolute. One can be more or less skillful; therefore, skill can be measured on some continuum.

Using this framework, one would be able to identify a skill and its' component knowledge and abilities, but not be able to determine if that skill is fundamental. As part of this research effort, we convened a workshop of noted contributors in fundamental or basic skills research. During this workshop, we asked these experts for their personal definition of fundamental skills. Although their responses were understandably mixed, they agreed that any definition or list of skills considered should define fundamental skills as prerequisite or enabling, capable of being modified through learning, and, above all, should consider the individuals' work context. There was no consensus as to what constituted the ideal list for the AF to pursue, since no list is all inclusive without further research in the particular work environment where it is implemented. As stated by one of our consultants, Thomas G. Sticht, "the concept of fundamental skills has no meaning outside the environment in which these skills are required to be used."

As suggested by our workshop participants and commonly presented in the literature, fundamental skills are those skills which underlie, or are prerequisites for, the learning and performance of more specific technical skills. If that is the case, two additional factors must be considered to determine if a skill is fundamental, context and range.

Context, with respect to skill, is the environment and situation in which a skill is used. A skill, whether it be reading, or hunting, exists independently of the context in which it was developed. However, whether the skill is fundamental, or of any utility, can only be determined in the context in which it is used. As an extreme example, fundamental skills required for success in an isolated tribal culture would be very different from those required in a modern technological society. Another example would be the different skill requirements of the military services. Although some generic requirements (e.g., reading, communicating, etc.) might be the same across all the services, many of the fundamental skills required for successful job performance could be expected to differ due to the nature of the individual service work context. Range refers to the variety of specific contexts in which a skill may be applied. For a skill to be considered fundamental, it should be required for the performance of tasks across a range of specific contexts.

In summary, fundamental skills can be narrowly defined as those skills required for the successful learning or performance of more job specific skills across a broad range of jobs within the context of the Air Force.

Definition Guidelines

Fundamental skills, as we have discussed them to this point, can thus be broadly defined as generic learned behaviors that are prerequisites for effective job performance. More specifically, they are:

1. Foundation behaviors required in the majority of AF jobs.

2. The building blocks upon which job-specific technical skills are based.

3. Modifiable behaviors and, as such, do not include generally immutable personal characteristics.

In order to define a specific set of skills, one must consider the various types of skills which can range on a continuum from extremely broad concepts to very specific task capabilities. We would define fundamental skills at two levels: (1) AF wide required (core) skills, and (2) Job Family/Cluster specific skills. The most fundamental of skills, or core skills, would be required to varying degrees in all AF jobs. These skills are nontechnological in nature, relatively free of explicit occupational content, and include basic educational skills (e.g., reading comprehension, writing, math), social skills, and other generic enabling skills. Some of these are probably being assessed (indirectly) by the Armed Services Vocational Aptitude Battery (ASVAB).

The ASVAB has been used in selection and classification of military applicants since 1976. It contains measures of knowledge in certain technical domains. The ASVAB Verbal composite, composed of Word Knowledge and Paragraph Comprehension, has been found to predict reading grade level scores for several commercial literacy tests (Waters, Barnes, Foley, Steinhaus, & Brown, 1988). The Arithmetic Reasoning subtest requires basic facility in numerical computations as well as reasoning ability. The Mathematics Knowledge subtest requires the solution of basic algebra, geometry, and decimal/fraction problems.

Several other fundamental skills in the perceptual and spatial domains are also measured by the ASVAB. The Coding Speed and Numerical Operations subtests both require perceptual speed skills. The Mechanical Comprehension test contains pictorial items on directional forces and related perceptual and spatial information concerning pulleys, gears, fluids, and other basic mechanical devices and substances. In addition to these more basic skills, the ASVAB measures technical knowledge in the vocationally-oriented areas of Electronics Information, Auto and Shop Information, and General Science.

The second level of fundamental skills (in addition to the core skills) would include skills which relate to more specific content domains and occupational categories. Examples of these skills might include skills pertaining to mechanics, tools/equipment, dealing with people, health, etc. As an example, fundamental skills for a maintenance specialty might include understanding schematics and gauges, whereas these skills would be less relevant for medical personnel. The important point here is that the identification of these clusters of skills will vary according to the specific context of the different occupational areas. Thus, under our taxonomic structure, the number of prerequisite fundamental skills which are influential (generic) for effective performance will increase with the levels of AF

classification as illustrated in Figure 1. Although not all of these skills would be required in all AF jobs, they might be required in the majority (80%?) of all jobs within a particular career field or family of occupational specialties.

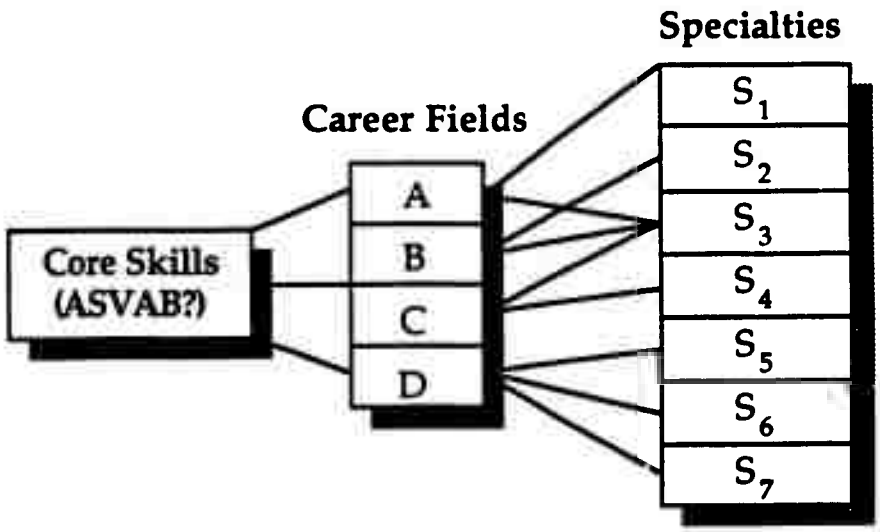

Figure 1. Fundamental Skills by Classification Levels

Job-based technical skills would be those required for performing specific job tasks and would thus not be considered fundamental. These would be technological skills exclusively and would number in the thousands across all AF Specialties. As an example, if one is trained as a Weapons Specialist, one would need a range of skills related to the arming, disarming, and loading of weapons, in addition to fundamental skills required to read instructions (of any sort) and communicate with co-workers.

Criteria for Applying Fundamental Skills

In addition to the criteria for defining fundamental skills contained within our definition, such as generic learned behaviors which are prerequisites for learning more specific job skills, there are additional criteria which refer to the application, or utility, of these skills within the Air Force work context. In establishing these criteria, we discussed various options internally, with our project consultants, and with the experts who comprised the workshop panel. Most of the criteria that eventually were identified emerged during these discussions. We also conducted a very focused search of the literature on training evaluation. The purpose of this search was to locate criteria used to assess the effectiveness of new training approaches such as those which might eventually be used by the Air Force for fundamental skills training.

These criteria include specificity, essentiality, measurability, and trainability, and are described as follows:

Specificity. The "specificity" criterion is concerned with the general utility of the proposed method for defining fundamental skills. The proposed method for defining fundamental skills must be specific enough to guide the analyst as he or she looks at work activities. However, it must not force the analyst to break work down to unmanageably low levels of detail. For example, we would not want simply to list "reading" as a fundamental skill, since it encompasses many different types of skill (e.g., "reading to learn," "reading to do"). On the other hand, we would not want to be so detailed that the method becomes cumbersome to use (e.g., listing 30 different reading skills).

Essentiality. This criterion reflects the need for fundamental skills to be linked directly to known or anticipated job requirements. Thus, a fundamental skill is one that is a prerequisite for skills considered "essential" for effective job performance. Skills may be considered essential if, for example: (a) they comprise a significant proportion of job time, (b) they can be used as a basis for separating adequate from inadequate performers, (c) the consequences of not being able to perform them are high (e.g., costly, dangerous to people or equipment), or (d) they are military requirements (e.g., DoD Directive, Number 1322.8, February, 1980).

Measurability. The "measurability" criterion is concerned with the need for fundamental skills to be objectively defined and publicly evaluated. Increases in skills are measured indirectly by assessing performance. Typically this measurement occurs immediately following a course of instruction. It may also occur following transfer to a work environment. Without this criterion, there would be no way to know if fundamental skills training efforts are having the desired effect.

Trainability. Some skills may be viewed as important, but there may be no evidence that they can be taught or learned given the time that is available. For our purposes, only skills which are "trainable" should be treated as fundamental.

In addition to the above criteria for evaluating the utility of the individual skill definitions for AF application, we would propose two additional criteria for evaluating lists of skills such as those we consider in this paper. These criteria are: theory based and conclusiveness:

Theory Based. Current research related to fundamental skills is oriented heavily toward cognitive and social understandings of learning, memory, and conceptual processes. Given the above, we believe that an approach, which ignores what is known about the learning process and the individuals cultural/social environment, or fails to account for the learner's existing knowledge or work context is likely to be inadequate.

Conclusiveness. The purpose of including this criterion is to provide for a reasonably complete and face valid sample of fundamental skills. There is a widely recognized "lack of fit" between the skills supervisors and managers want and the skills that traditional basic skills programs make available. The proposed method for defining fundamental skills must provide for coverage of the range of skills that generally are regarded as important and fundamental. For example, an approach that just looked at reading would seem inadequate. Likewise, an approach that only looked at individual skills without regard for cooperation and teamwork would appear inadequate (e.g., Congress of the United States, Office of Technology Assessment, 1990; Heath, 1991).

Application of the Criteria

As a demonstration of the skills identification guidelines and criteria we have proposed, we evaluated several proposed "lists" of fundamental skills for possible AF application. Since the theories or programs from which these lists originate will be discussed in greater detail later in this paper, we have provided only a reference to how these skills meet our criteria in this section. These evaluations are, admittedly, subjective estimates by two authors of this paper and are presented here for demonstration purposes only.

The skills we evaluated include those listed by the Secretary's Commission on Achieving Necessary Skills (SCANS) (U.S. Department of Labor, 1991), and the Army's Job Skills Education Program (JSEP) (Farr & Ward, 1988). Both of these lists are theory based, in that they are derived from a consideration of the individual's existing knowledge and work context. Both of the lists are also conclusive in that they provide a reasonably complete lists of skills, although they differ in emphasis since the SCANS list is derived from a review of the literature and expert input, and JSEP is the result of an extensive analysis of academic skills related to performance of tasks in 94 Military Occupational Specialties (MOS's). In terms of conclusiveness, these two different approaches to identifying (defining) fundamental skills lead to different outcomes. SCANS, with its emphasis on skills needed in the workplace as described by the U.S. workforce members, includes skills of a social, interpersonal nature. JSEP, on the other hand, focuses on cognitive skills required to learn various job tasks which are not currently taught on-the-job or in existing Army technical training courses.

The SCANS has proposed a list of 16 fundamental skills which they regard as the foundation for effective job performance (Table 1). Our subjective evaluation of how well these skills, as defined by the SCANS, meet our criteria revealed that "Responsibility," "Self-Esteem," and "Integrity/Honesty" would not be considered as fundamental skills. While these characteristics may reflect attributes that employers desire in their employees, they do not meet our criteria of specificity and trainable, and are questionable regarding measurable. Further, it seems difficult to us to consider these attributes on a skill continuum, e.g., how could one be skillfully honest?

Table 1. SCANS Foundation Skills

A THREE-PART FOUNDATION

Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens, and speaks

A. *Reading* - Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules

B. *Writing* - Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts

C. *Arithmetic/Mathmatics* - Performs basic computations and approaches practical problems by choosing appropriately from a variety of mathmatical techniques

D. *Listening* - Receives, attends to, interprets, and responds to verbal messages and other cues

E. *Speaking* - Organizes ideas and communicates orally

Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons

A. *Creative Thinking* - Generates new ideas

B. *Decision Making* - Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative

C. *Problem Solving* - Recognizes problems and devices and implements plan of action

D. *Seeing Things in the Mind's Eye* - Organizes, and processes symbols, pictures, graphs, objects and other information

E. *Knowing How to Learn* - Uses efficient learning techniques to acquire and apply new knowledge and skills

F. *Reasoning* - Discovers a rule or principle underlying the relationship between two or more objects and applies it in solving a problem

Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, integrity, and honesty

A. *Responsibility* - Exerts a high level of effort and perseveres toward goal attainment

B. *Self-Esteem* - Believes in own self-worth and maintains a positive view of self

C. *Sociability* - Demonstrates undestanding, friendliness, adaptability, empathy, and politeness in group settings

D. *Self-Management* - Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control

E. *Integrity/Honesty* - Chooses ethical courses of action

The 180 skills listed by the JSEP are summarized within the taxonomy presented in Appendix B. All these skills would appear to meet our criteria. This is not surprising since our criteria are heavily influenced by a training needs analysis model which is compatible with the JSEP approach. However, for AF application, we are unable to evaluate how well any of these skills would meet our essentiality criterion as they are based on an analysis of Army job requirements compared to what is being provided in current Army training, and may be unrelated to AF needs.

This important distinction is discussed further in our section where we describe the JSEP methodology in greater detail.

Several other lists we reviewed for this paper did not meet our criteria because they were atheoretical in their approach and included a number of behaviors or attributes that employers would like their employers to possess. These attributes, to a large extent, do not meet our criteria for fundamental skills. Surveys of employers conducted by the American Society for Performance and Development, and the Michigan Employability Skills Tasks Force discussed in the next section are examples of these types of lists.

In summary, this section has provided a definition of fundamental skills and how skills defined in such a manner relate to the broader domain of human capabilities or competencies. We also proposed criteria for both defining and evaluating fundamental skills for AF application. The framework provides a way to evaluate the various conceptual orientations for defining fundamental skills. A review of these orientations is presented in the next section.

III. CONCEPTUAL ORIENTATIONS

Conceptual orientations for defining fundamental skills may be grouped loosely under two broad categories, atheoretical and theoretical. Atheoretical orientations include defining fundamental skills in terms of existing policy, or defining them on the basis of expert opinion. The focus on literacy instruction in the military, for example, appears to have been driven by policies aimed at addressing an important and widely recognized deficiency (e.g., Duffy, 1985). Likewise, any approach based wholly on subject-matter expert opinion, or suggesting supervisors, managers, and others can define the fundamental skills needed to succeed in the workplace (e.g., Carnevale, Gainer, & Meltzer, 1989), must be regarded as largely atheoretical.

Theoretical orientations have derived largely from three scientific disciplines concerned with human behavior: (1) Psychology, (2) cultural anthropology, and (3) sociology. Each of these disciplines has a slightly different emphasis on the nature of variables that shape and drive human behavior, as well as different preferred data collection techniques.

Atheoretical Approaches

To a significant extent, some lists of fundamental skills appear to have been defined by policies based on tradition, or established wholly on the basis of "expert" opinion. As a result, rationale supporting one means versus another for defining these skills is generally lacking. Fundamental skills have been defined very narrowly (e.g., reading skills) when much broader conceptions appear equally justified, or defined so broadly that there are few apparent boundaries on what they can encompass (e.g., creative thinking/problem solving). There also has been a

tendency to overlook important differences in tasks which, on the surface, appear unitary, but almost certainly are not (e.g., reading tasks). There are important exceptions to this rule. Sticht (1979), for example, distinguished between "reading to do" and "reading to learn" on the basis of the information processing requirements of the two types of tasks. In the former, the reader seeks a particular piece of information for immediate use in performing some task. In the latter, the individual reads larger segments of information and stores this information in memory for later use. However, fundamental skills programs have been just as apt to treat reading as "reading," regardless of the nature of the material to be read (e.g., prose, forms and charts integrated with print).

When fundamental skills have been defined by policy, they usually have been treated under the rubric of literacy. Where literacy has been seen as a problem, organizations have tended to institute programs aimed at improving reading alone, or reading and arithmetic to correct it. Other subjects, such as study skills, may be treated as well, but the focus has tended to remain on reading. Additionally, the programs have varied in job relevance, from ones which are very functionally oriented (e.g., Sticht, 1975) to ones which bear no apparent relationship to the job. For example, the Army's Basic Skills Education Program (BSEP) had as its stated objective providing "basic literacy instruction in reading and arithmetic to form a basis for Military Occupational Specialty training" (Duffy, 1985). The initial BSEP program was decentralized and geared toward general literacy--each Army post contracted with local school districts for its own BSEP program. It was this lack of apparent job relevance that led the General Accounting Office to recommend that BSEP be terminated.

When fundamental skills have been defined by opinion, they may refer to the "skills employers want" or "business needs." However, it is not clear that consideration for skills at this level is always particularly meaningful. To be sure, employers want their employees to be capable of creative thinking and problem solving. They want people who are personable and who are team players as well as ones who show sound leadership skills. It is appropriate to talk about these needs on one level (e.g., Carnevale, Gainer, & Meltzer, 1989) (Figure 2). However, it is not clear what is (or is not) meant by some of these skills. Indeed, a fundamental skill like "problem solving" could be regarded as including virtually all forms of human activity. Thus, without being able to isolate how problems are solved, we cannot know if problem solving is a transferable skill. Indeed, there is the strong possibility that problem solving is not really a context-free, single skill but rather a label which hides the fact that several situation-specific skills are involved. This sort of labeling risks the danger of suggesting generic, unitary skills which do not really exist.

At another extreme are the taxonomies of educational objectives developed by Bloom and his associates in the cognitive domain (Bloom, 1956) and affective domain (Krathwohl, Bloom, & Masia, 1964). Later, Bloom, Hastings, & Madaus (1971) prepared a handbook that gives many examples of educational objectives in both domains. These taxonomies were designed to be generic so they apply to many

subject areas at all school levels. While many of the objectives are worthy of consideration as fundamental skills, many are so specific that they offer little (apparent) hope of direct application to the area.

While lists of skills generated by atheoretical approaches may be challenged from a scientific perspective, it seems to us that fundamental skills which are continuously listed by supervisors and workers as being important should not be slighted. Further, many of the skills identified in this fashion have some grounding in the various theoretical approaches considered in the following discussion.

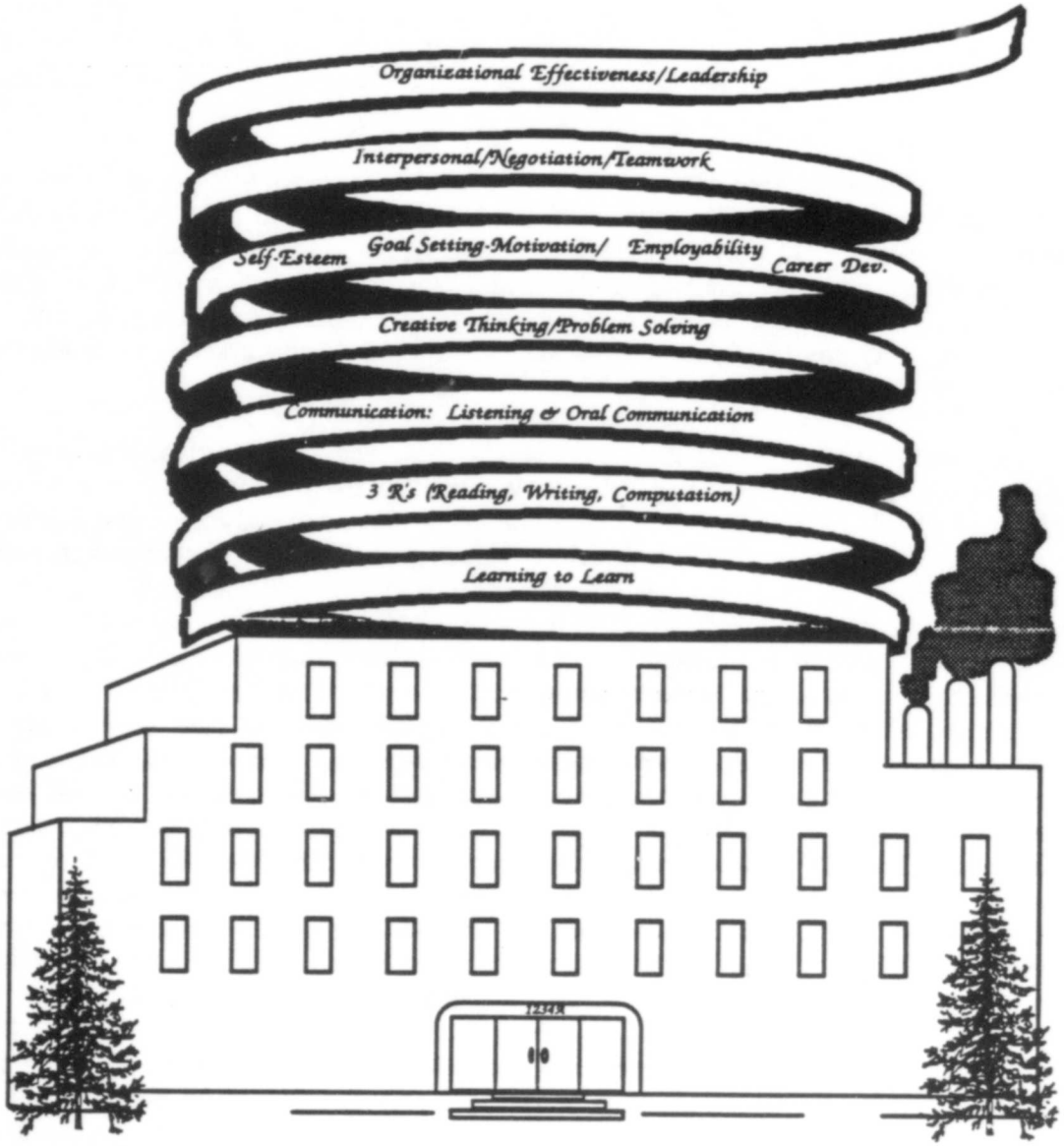

Figure 2. Carnevale, Gainer, and Meltzer (1989) Workplace Basics

Theoretical Approaches

Psychological

Psychology focuses on individual differences in understanding human behavior. Psychologists tend to analyze cognitive aspects of skills and learning, including individualized assessment and training programs. The psychologist would tend to focus on the individual's unique characteristics or implement development programs for unique developmental needs. A test such as the ASVAB would be used to assess current abilities, and placement or training programs would be implemented based on the individual's current skill level. The psychological approach may tend to downplay ethnic diversity and tends to implement programs based on each individual's unique set of abilities and skill levels.

Psychological approaches to fundamental skills have their theoretical roots in behavioral psychology. These roots extend back in time at least to the early 1900's when Thorndike (1911) described learning in terms of the formation of "connections" or "bonds" between a stimulus and a response, or series of responses. In this view of learning, there are no intervening elements or variables. Learning is essentially mechanical. Connections are "stamped in" over a series of trials through the automatic action of reinforcement.

Beginning about 1920, theorists of the connectionist tradition began to call themselves "behaviorists," and John B. Watson (1925) was the first psychologist to refer to himself as a behaviorist. He was interested in studying what stimulus (S) produced what response (R), and what stimuli produced what changes in behavior. Early cognitive learning theorists (e.g., Tolman, 1932) and Gestaltists, on the other hand, argued that learning involves a process of organization that must be studied as a whole. For them, learning was not random and mechanical. It was not something that could be broken down into a series of connections. Instead, it was the consequence of organized, meaningful experiences. At one time, there was a definite division between psychologists who believed that an S-R learning model comprised all behavior and cognitive theorists who emphasized that all behavior involved mediating processes. At present, neither of these extreme views are held too rigidly, if at all. There are psychologists who primarily study behavior that fits an S-R model (e.g., Skinner, 1938), and others whose study is focused on cognitive processes. A more broadly balanced, or unified, approach to learning theory now appears to exist. Even so, behavioral models of instructional development and current classroom practices have tended to remain tied to a basic S-R model.

Manifestations of the S-R approach are reflected in the emphasis that behavioral models place on the objective and observable aspects of human behavior. Notions related to design of instruction (e.g., Gagne, 1962, 1965, 1968), which culminated in the Instructional Systems Development (ISD) model, place the focus squarely on the objective analysis of what is done and accomplished during skill performance.

Conventional ISD and task analytic procedures are intended to deal with training inputs and response outputs, not with what happens in the processing of the inputs to produce outputs. As a result, analytic effort is spent identifying the observable events which "cue" the initiation of an action, determining what is to be done in terms of objectives to be accomplished, and defining criteria for successful completion of an action. Then, attention is directed toward prescribing ways to relate the various tasks and conditions for performance to instruction and instructional equipment.

Over the last 10 years, it has become increasingly evident that, while behavioral models of instruction can be used to support training on many tasks, they may not be effective for others. Behavioral models work well when dealing with tasks that are more procedural or "mechanical" in nature, such as assembling a rifle or measuring the straight-line distance between two points on a map. These types of tasks generally involve completing a series of steps in a particular order. However, behavioral models are less effective when dealing with tasks that involve complex problem solving and decision making. For these tasks, there frequently are multiple ways to frame the problem, and there typically is no simple solution. As importantly, many of the steps taken by a performer in completing these tasks are invisible to the observer. Without a workable instructional model, tasks involving complex cognitive processing tend systematically to be passed by in favor of more readily trainable and testable tasks. When more cognitively demanding tasks are trained, they usually are not trained well. Efforts are made to make these tasks fit a mold that is not suited for them. This "mold fitting," in itself, may account for many of the problems that have been encountered over the years in attempting to deal with fundamental skills training.

A behavioral orientation also is evidenced in the assumption that knowledge and skill can be broken down into their component parts, and then recombined at will without ill-effect. Said another way, if one has the requisite "pieces," one has the whole. This assumption underlies the "building-from-the-bottom" approach that is the basis for most civilian and military instruction. It also is closely related to the view that learning is largely context-independent, that information acquired in the learning environment will transfer directly to the using environment. As evidenced in the next section, there are now many good reasons to doubt the validity of these assumptions and views (e.g., Brown, Collins, & Duguid, 1989).

There are several good examples in the literature where an effort has been made to define and train fundamental skills using a behavioral instructional model (e.g., Duffy, 1985; Sticht, 1982). Most of these approaches have not been very successful. Sticht (1982), for example, reports learning gains while enlisted men were in generic basic skills classes, but the loss of those learning gains within 2 months. No connection between the jobs and skills learned in classes were apparent to learners. As another example, Kent (1973) administered tests at two times, four months apart, to a sample of 2,300 students in adult basic education classes. The classes were in 90

different programs in 15 states. He found the average reading and math gains to be 0.5 and 0.3 grade levels, respectively.

Mikulecky and colleagues have suggested that isolated fundamental skills may not be important determinants of job performance. Learning fundamental skills and how to connect those skills to particular contexts and problems may be what is key. Mikulecky and Winchester (1983) examined fundamental skills related to job performance of nurses, and Mikulecky and Ehlinger (1986) performed a similar study with electronics technicians. In both studies, basic reading skills such as those measured by generic tests did not separate top job performers from below-average performers. However, the ability to use reading and other skills to find information, make predictions, monitor self-performance, and formulate questions was related to job performance. Results such as these suggest current cognitive and social orientations may be more important to understanding fundamental job skills than behavioral learning frameworks.

Cognitive Psychology. Current cognitive theories (e.g., Jones & Idol, 1990; Resnick, 1987a, 1989) of the learning process provide one framework for addressing issues related to the definition of fundamental skills. As summarized by Resnick (1989), these theories may be characterized as emphasizing three related views: (1) Learning is a process of knowledge construction, (2) learning depends heavily on the use of existing knowledge, and (3) learning is most effective when skills are practiced or "situated" in the environments in which they are used.

Each of these views is discussed, in turn, in the following sections. Of course, in considering these views, we must remember that not all cognitive theorists agree on how knowledge is constructed, or how existing knowledge affects learning, or what the notion of "situated" learning actually entails. Different ideas abound in all of these areas, and any (or all) of them hold potential for how fundamental skills ultimately are defined.

Cognitive theories hold that the learner plays a very active role in the learning process. The learner is seen not just as one who picks up and stores new information, but as one who constructs and interprets information and relates it to existing knowledge. To be skilled, it is argued, is not just to know how to perform some action, but also to know when to perform it and how to adapt the performance to satisfy various situational constraints.

Instruction is viewed as important, not because it results in the direct transfer of information, but because it supports the learner's need for information during the knowledge construction process. This support includes stimulating and aiding knowledge development, but it also includes providing proper direction or guidance to this development. Direction must be established to assure that the knowledge that is developed is both "true and powerful." True in the sense that it provides a good description of the world, and powerful in the sense that it is both lasting and useful (Resnick, 1989).

Viewing learning as a process of knowledge construction implies the presence of a wide variety of underlying mental activities or processes to support this construction. These mental activities or processes, which are kinds of "cognitive tools," are thought to include such things as the plans, strategies, intentions, elaborations, and representations of the individual learner. They also may include "metacognitive skills" (Brown, Bransford, Ferrara, & Campione, 1983), which are essential in developing knowledge about one's own cognitive states and abilities, and in the use of cognitive strategies (e.g., Pylyshyn, 1978). For the present argument, the nature of the cognitive tools is probably less important than the understanding that tools--good tools--are needed to support the knowledge construction process.

Current cognitive views stand in contrast with prevailing educational theory and practice (Jones & Idol, 1990; Resnick, 1989). At a minimum, these views challenge behavioral orientations toward learning that recognize hierarchies of objectives and forms of learning (e.g., Bloom, 1956). They also are contrary to the standard classroom practice of sequencing activities from those activities that do not require much independent thinking or problem solving--"drill on the basics"--to those that do (e.g., Resnick, 1987a). Indeed, when viewed from the perspective of cognitive psychologists like Resnick (1987a, 1989) much of today's educational theory and practice appears completely topsy-turvy. Activities that once were seen as being dependent on the "highest forms of learning" (e.g., problem solving) now are viewed as engaging very basic, cognitive activities and processes. Similarly, the most basic cognitive skills, such as elementary reading and mathematics, are now recognized as demanding the use of cognitive tools that require considerable development and that may be lacking in many students. What makes these views even more compelling is that supposed "traditionalists" like Bloom also have been arguing in favor of revolutionizing educational theory and practice in ways which are very much in line with this same type of thinking (e.g., Chance, 1987).

Some skills referenced in this paper and defined in the literature as fundamental would not be regarded as such by cognitive scientists (e.g., "problem-solving and creative thinking", and "self-esteem/goal setting"). To a cognitivist, such higher-order skills are seen as amalgams of sundry basic skills. Put simply, a "basic" skill is a process that can transform a sensory or memory input into a mental representation that allows subsequent cognitive work to be carried out. For instance, "encoding" (i.e., the feature-recognition and interpretive analyses where a stimulus is abstracted from the environment and stored in working memory -- operationalized as the minimum trace duration followed by a mask needed to recognize the stimulus) is seen by cognitivists as a "basic" skill. Encoding improves with both age and practice, and sets limits on the efficiency of higher-order thinking skills. Similarly, scanning of the contents of one's working memory, retrieving the information from long term memory, matching features of one stem to those of another in an analogical reasoning task, and so on, are all seen as "basic" skills that set limits on subsequent cognitive processing. In contrast, problem-solving and creative thinking are not so much basic skills as they are amalgams of many basic skills: they entail coding, scanning, matching, retrieving, etc. Performance on a

problem-solving task, for instance, can be derailed if the individual fails to carry out a single basic skill properly.

However, according to most cognitive theorists, it would be a mistake to believe that skills can be arranged into some type of thinking or problem-solving hierarchy, where fundamental skills appear as the "lower order" skills at the bottom of this hierarchy (although fundamental skills can be considered as prerequisites for acquiring subsequent knowledge and technical skills). Fundamental skills may be effectively defined in other ways, but not this way. It also would be a mistake to assume that higher order thinking only characterizes learning at more advanced levels. This kind of thinking is essential to effective learning of all types. Less directly, it provides a basis for expanding conceptions of fundamental skills to include the activities or processes underlying the knowledge construction process--cognitive tools, such as strategizing, planning, and metacognition. Any approach toward defining fundamental skills that does not include consideration for these tools is likely to be inadequate.

A second important aspect of current cognitive theories is their emphasis on the role of prior knowledge in learning. This emphasis does not deny the existence of "general" cognitive processes and activities like metacognitive skills. However, it does raise serious questions about the potential utility of addressing these skills apart from specialized content areas. Evidence attesting to the importance of prior knowledge to learning, thinking, and problem solving comes from at least four converging lines of research. This research includes studies in: (1) developmental psychology, (2) expert and novice problem solving, (3) aptitude and intelligence, and (4) transfer of training. Much of the research in the first three areas was reviewed earlier by Glaser (1984). The fourth area, due to it's importance regarding how best to train fundamental skills, deserves further discussion.

Transfer of training is said to occur whenever the effects of prior learning influence the performance of a later activity. In this very broad sense, transfer is an extremely widespread phenomenon, playing a part in almost every instance of learning. It also is in this very broad sense that the knowledge and skills acquired throughout life seem cumulative, so as adults, we rarely, if ever, are forced to learn anything completely new. Yet, the amount of transfer that actually takes place in a given situation is another matter. Commenting on early research upon transfer, Postman (1971) observed that: "...the repeated failures to find broad transfer effects implied that the habits permitting the efficient performance of a given task were highly specific and unlikely to generalize to new situations" (p. 1032).

Such failure of transfer is found in more recent studies as well. As an illustration, efforts to enhance intellectual performance by training cognitive skills, like thinking and problem solving, have met with surprisingly little success. The skills simply do not transfer to novel contexts (Bransford, Arbitman-Smith, Stein, & Vye, 1985; Polson & Jeffries, 1985; Simon & Hayes, 1976). As noted recently by Perkins and Salomon (1989):

> To the extent that transfer does take place, it is highly specific and must be cued, primed, and guided; it seldom occurs spontaneously. The case for generalizable, context-independent skills and strategies that can be trained in one context and transferred to other domains has proven to be more a matter of wishful thinking than hard empirical evidence. (p. 19)

Positive transfer has often been hypothesized to be a function of the number of elements in common between two tasks. Anderson (1987) views production rules as the common elements of transfer. According to Anderson (1987), "knowledge comes in declarative form, and is used by weak methods to generate solutions, and the knowledge compilation process forms new productions. The key step is the knowledge compilation process, which produces the domain-specific skill" (p. 197).

Procedural learning has a direct consequence for skill transfer. There is no reason to predict transfer between different uses of the same knowledge. Practicing troubleshooting, for example, may strengthen the declarative representation of troubleshooting knowledge while that knowledge is being interpreted by general problem-solving productions. However, this interpretative stage passes quickly. Once the knowledge compilation mechanisms start forming new domain-specific productions, then additional practice results in increasingly specialized productions. To the degree that the transfer task requires the same procedures, positive transfer will occur. To the extent that it requires different procedures (even those based on the same declarative knowledge), transfer will not occur. Several laboratory studies support this prediction (Neves & Anderson, 1981; McKendree & Anderson, 1987).

The failure to show clear evidence of transfer is by no means limited to laboratory tasks. This is just as true for more practical, applied skills like troubleshooting. The extent to which troubleshooting performance is influenced by instruction is highly related to the level of explicitness of the action-related information that is provided (e.g., Morris & Rouse, 1985). It also is true for generic basic skills programs designed to train skills like reading (e.g., Sticht & McDonald, 1989; Mikulecky & Winchester, 1983; Mikulecky & Ehlinger, 1986). This train[illegible], rarely has much, if any, positive effects on later job performance. What positive effects it does have appear to fade rapidly with time.

These transfer of training issues have important implications for fundamental skills training where skills are taught in generic programs which, to a large extent, are separate from the context in which the skills need to be applied. Since these skills are, by definition, generic and prerequisite for learning more job specific skills, it is critical that the learning transfer to the job context. Two recent conceptual approaches which address this issue directly are situated learning and functional context discussed in the following paragraphs.

The view that learning and cognition are "situated" assumes there is a close connection between knowing and doing, or between "knowing what" and

"knowing how." (e.g., Brown, et al., 1989). It assumes that activity increases learning, and it supports methods of instruction, like apprenticeships, which recognize the importance of giving the learner "hands-on" experience in a meaningfully-structured performance context. For learning to be situated, the purpose for the task must arise out of a macro-context (e.g., the job, not an instructional directive), and the learner's assessment of success must depend on outcome information he or she receives within that context (e.g., "Was I able to read to solve this job task and move on?" versus "Was I able to pass the reading test on this material?").

In accord with this line of thinking, the learner's experience must be considered to understand the learning that is taking place. For example, experiences with concepts and relations in school frequently are quite different from related experiences in the real world. A number of researchers have pointed to these differences as a critical factor underlying the failure of transfer from schooling (e.g., Brown, et al., 1989; Resnick, 1987b).

Resnick (1987b), for example, noted four important contrasts between in-school and out-of-school learning and thinking activities that raise serious questions about the general utility of schooling for nonschool activities, to include work. She noted that, while in-school learning revolves around individual activities, much activity outside of school is socially shared. (Further discussion of some implications of this point follow below in the sociological section of this paper.) Second, in-school learning emphasizes "pure thought" activities without the aid of various types of tools, where most mental activities outside of school depend heavily on the use of tools. Third, in-school learning places a premium on abstract symbol manipulation, where out-of-school activities tend to involve reasoning and actions connected with physical objects and events. Finally, in-school learning tends to be geared toward teaching general skills and principles. However, success outside school depends on the development of domain-specific competencies.

As suggested by Palincsar (1989), there are three key advantages to treating learning and cognition as situated: (a) it grounds education in a practical world of experience; (b) it provides the framework needed for organizing and retaining new knowledge; and (c) it holds potential for giving students a sense of urgency, power, and confidence in their learning. The clear implication is that in regarding learning and cognition as situated, learning and retention will be better than otherwise would be the case. Perhaps even more importantly, that which is learned will transfer to the job.

Among current orientations to fundamental skills education, the functional context approach must be regarded as primary in its emphasis on the need to situate learning in the using context. The term, functional context, refers to the instructional design using materials, books, tools, and language of the working environment adjusted to the knowledge and experience of the students. Sticht and Mikulecky (1984) describe the approach as follows:

> The functional context principle states that skills and knowledge are best learned if they are presented in a context that is meaningful to the person. Thus, rather than teaching students who need job-oriented basic skills to read, write and compute using general literacy materials, it is better to use job reading and numeracy materials and tasks. The more similar the basic skills training tasks are to the actual job tasks, the greater will be the likelihood that the training will pay off in improved performance of job literacy tasks. Thus, for youth and adults aiming at work in a given industry or organization, the use of job-related materials serves two purposes. On the one hand it provides a functional context for the learner--that is he or she can see that the materials are relevant to the employment goal--and hence motivation to use the material is elevated. On the other hand, the organization can see that the training is relevant to its needs and that there is some likelihood of the trainees actually becoming competent in the performance of job-relevant skills. Thus, organizational motivation to participate in the training is gained. (p. 33)

A wide variety of research has demonstrated the feasibility and effectiveness of integrating the teaching of vocational knowledge and reading instruction (Sticht, Armstrong, Hickey, & Caylor, 1987). In general, programs designed using a functional context approach produce at least as much gain in "general" literacy as generic programs. In addition, however, they produce substantially more gain in job-specific reading skills than do the generic programs. Programs which are particularly noteworthy among initiatives in the fundamental skills area, and ones that employed a functional context approach, are the Army's Job Skills Education Program (JSEP) and the Air Force's Job Oriented Reading Program (JORP).

JSEP was developed, in part, as a result of earlier CAO criticism concerning the job relatedness of the Army's existing Basic Skills Education Program (BSEP). BSEP was not linked to specific job requirements and was designed under the theory that improvements in general reading levels would lead to improvements on the job. JSEP is discussed in detail later in this paper, and both JSEP and BSEP are described in Appendix D. JORP was an Air Force research project undertaken to examine questions concerning job-specific versus general literacy as the best approach for fundamental skills training. The two major objectives of the JORP were: (1) to demonstrate the feasibility of using a job-related approach with airmen in training, and (2) to test the effectiveness of this approach in an organizational setting by using job-related reading materials (Huff, Sticht, Joyner, Groff, & Burkett, 1977).

The functional context approach of JORP emphasized the use of actual job-related information from manuals and other sources as training materials. JORP training was integrated into the regular duty day of the students, and time available for training was 2-1/2 hours per day for six weeks. Results of a 1976 test of the JORP prototype indicated that although there were no significant gains in the overall

reading ability of the students, there were significant gains made in job-specific reading skills (Huff, et al., 1977).

The JORP research effort was later discontinued when apparently the Air Force decided to pursue cognitive processing in problem solving, rather than literacy skills, in the basic skills R&D program. The project was transformed into a search for methodologies for analyzing the knowledge and skills needed to be an expert technician in high technology fields. As stated by Gott (1986), basic skills are:

> ...skills that bring the airman to a functional level faster; skills that help to reduce the information overload condition; skills that ease the intellectual transition from the job to job and complex system to complex system; and finally, skills that are in fact basic to sustained success in high-tech workplaces. (p.110)

It seems to us that this definition provides an eloquent description of useful skills, but not necessarily fundamental skills. Many skills which would fit within this definition could be highly technical and job task specific in nature (e.g., electronic troubleshooting). Further, to identify skills, such as those required to "reduce the information overload" imposed by a particular task could well be a very expensive and long-term undertaking.

Human Factors and Job Aiding. At the micro level, human factors focuses on optimizing fundamental skills through design/redesign of equipment, machines, and tools, including displays, controls, signs, and labels. Design features are selected in consideration of human limitations and capabilities (e.g., perceptual, cognitive, and psychomotor). At a higher level, known as macroergonomics, human factors takes a top-down approach to design based on a sociotechnical system perspective (Hendrick, 1986). This perspective recognizes the importance of the fit of jobs and organizations into the social and cultural milieus in which humans are embedded.

Traditionally, human factors applications in the fundamental skills arena have focused on simplifying the job either by reducing demands associated with reading or eliminating them. They have included consideration both for the extent to which various kinds of written materials are used on the job (e.g., Sticht, Fox, Hauke, & Zaps, 1977) and for the reading difficulty of the materials available for use on the job and in training (e.g., Kincaid, Fishburne, Rogers, & Chisom, 1975). They also have provided for the integration of job performance aids into individual career systems. This latter approach is exemplified by recent work by the Navy on the Enlisted Personnel Individualized Career System (EPICS) (Smillie & Clelland, 1986).

Under the EPICS program, the Navy divided job activities associated with the maintenance of the Sea Sparrow missile system into basic and advanced levels. They then looked at the knowledge and skill demands for the entry level and determined whether they could support performance with a job performance aid or

whether individual training was required. In the final EPICS system, individuals received minimal initial training. They then entered the job as apprentices, with their work being supported by job performance aids. Most of the aids emphasized the use of visual materials for less literate personnel. As these people became more proficient in their jobs, they then returned for more advanced training. One effect was to increase the value of time spent in training--the training was more meaningful to the trainee. Other achievements of the EPICS program included expanding the personnel pool for technical jobs by using lower aptitude and lesser skilled personnel, and facilitating personnel adaptation to the military job, social, and physical environments.

If the fundamental skills problem is seen as one of achieving effective on-the-job performance from less-skilled personnel, an approach like EPICS holds considerable appeal. Properly designed, job performance aids can provide several benefits that training alone cannot deliver. A key advantage of job performance aids is that they can provide task-specific information to those who need it when they need it. Additionally, they can be used to overcome problems associated with forgetting. Tasks most amenable to job aiding, such as procedural tasks, are typically among the most susceptible to the effects of forgetting (e.g., Schendel & Hagman, in press). Also, job performance aids can be designed to account for user characteristics such as job-relevant skills, knowledge, experience, and reading level (Smillie, 1986). If job aiding has a shortcoming, it is in the number and types of tasks to which it can be applied. The use of a job aid "crutch" may not be practical in situations demanding immediate, corrective action. Also, job performance aids usually are of little value in promoting performances that have a large skill component.

The Air Force has a project called Job-Aiding/Training Allocation Technologies (JATAT) being researched in the Technical Training Research Division of the Armstrong Laboratory. The goal of this project is to develop systematic ways to decide if tasks should be job-aided, trained, or whether some combination of both is required (Rouse & Johnson, 1990; Zenyah, Frey, Rouse & Lamb, 1991; and Irvin, Blunt & Lamb, 1988).

Cultural/Social

Fundamental skills as we have described them are culturally defined within a given social context. Thus, the disciplines of anthropology and sociology provide meaningful input for consideration. Anthropology, and it's subdiscipline, cultural anthropology, studies societies and the effect of culture on human behavior. As such, it often focuses on "modal personality" or "modal skills." These are the personality characteristics or skills that are prevalent within the culture. For example, LaBarre (1945) described the Japanese as being characterized by precision, perfectionism and conformity to rules. Others have characterized the Japanese as having strong quantitative or numerical skills. The anthropologist would tend to recognize cultural diversity in the workforce and would focus on the skills that are inherent in particular ethnic groupings.

Sociology studies the statics and dynamics of individual and group interaction, as well as the forms and change processes in major social institutions, societies, and world systems. Again, it concentrates on the norms, values, beliefs, and patterns of behavior, or "modal behavior." The sociologist would tend to recognize social diversity in the workforce and the strengths characterized by certain groupings of individuals. For example, the sociological perspective would identify commissioned officers from certain socio-cultural backgrounds.

An individual's knowledge construction is influenced by society, and the environment in which skill are employed is social as well as physical psychological. A number of social forces and processes are involved in the determination of which skills individuals and societies will value. In addition to being cultural, language is a social symbol system, and the particular structure and usage of language influences thinking and reinforces social values.

Cross-cultural studies of thinking have tended to be biased toward one of three views of non-Western, or alien, idea systems. Shweder (1984) refers to these views as evolutionism (or developmentalism), universalism, and relativism. Each of these views is discussed in the following paragraphs.

Developmentalists typically deny that the dictates of reason and evidence are equally available to all persons or peoples. According to Shweder (1984), early anthropologists such as S. Tylor and J. Frazer as well as more recent theorists (Piaget, 1966; Horton, 1967) argue that the logic and normative standards by which thinking or action is judged as successful or unsuccessful undergo development. Only a few civilized cultures possess scientific logic in this view. Evolutionary theorists argue that concrete, occasion-bound thinking is common in primitive cultures. Such thinking has been explained by reference to one or more types of cognitive "deficits" involving skills, motivation, knowledge, and language. As an example, Luria (1976) concluded that, for some cultures, abstract classification procedures are alien. Luria credited formal schooling with fostering the ability to generalize and think scientifically.

According to Shweder and Bourne (1984), some societies lack the intellectual motivation to reflect on alternative cultural practices. Their concrete thinking is seen as an adaptation to life which is embedded in a cultural "cocoon." Behavior and cognition are tied to contexts and details which are not conducive to abstraction. They also point out that impoverished language impedes abstract thought. Speakers of languages which do not have general terms for classes of entities are said to be prone to overlooking similarities among things. For example, in Tasmanian, each variety of tree has a specific name, but there is no equivalent for the term "tree."

Universalists believe there are general laws, "natural" tendencies, and deep structures which apply to all cultures. Levi-Strauss (1966), for example, sees a human tendency to think in terms of binary oppositions such as voiced/unvoiced (in phonetics), exogamy/endogamy (in marriage systems), and liberal/conservative

(in politics). Chomsky (1968) has theorized that universal structural principles determine how a child learns the rules for specific languages. One of these principles concerns deep structure which deals with the abstract relationships among words in a sentence. From the universalist perspective, attributions of differential abstractness among cultures are illusory and merely indicate that the category systems of one fail to align with the category systems of another. For instance, Micronesian navigators show phenomenal memory, inference, and calculation skills when sailing from island to island, but perform poorly on standard Western tests of intellectual functioning. Cognitive skills are often applied in everyday social or economic situations without being abstracted from context.

The universalism approach to culture is closely associated with the structuralism approach in sociology and sociolinguistics. The basic structuralist strategy is to regard language as the underlying model of social reality. Language is seen as a collective representation whose meanings are imposed by society. In addition, language has an underlying rule structure which specifies the relationships among parts of speech. According to Levi-Strauss (1966), all social symbol systems have an underlying structure which, like language, defines relationships among social entities, such as family relationships, art, religion, and mythology.

Relativists see differences among cultures as real and seek to preserve the diversity of human societies and ideas. In the view of relativists, ideas and behavior of alien cultures makes sense given the context (premises, standards, etc.). Relativists believe that equally rational people can look at the same world, and yet arrive at different understandings and conclusions. To the extent that no "universal" rule or law of nature dictates what is proper or necessary to believe or value, there is an arbitrariness to our comprehension. Social consensus guides logic. To the relativist, objects and events are not categorized together because they are more alike than other things. Contrarily, objects and events seem to be alike because they have been classified together normatively (Shweder, 1984).

Properties of Culture. According to LeVine (1984), culture has collective, organized, multiplex, and variable properties. A shared consensus on a wide variety of meanings exists among members of a cultural group. Group members can vary greatly in feelings, thought, and behavior, yet still hold common understandings of the symbols and representations such as gestures, property, graphics, careers, and relationships essential for social interaction.

The framework of cultural ideas and values is an organized set of contexts from which customary beliefs and practices take on meaning. An example of cultural organization is success. Success involves competitive, economic, occupational, prestige, recognition, self-esteem, and self-satisfaction implications which are interrelated. A promotion at work means more than just higher pay.

In addition to being collective, organized, and complex, LeVine (1984) views cultures as variable. Universalists view variations across cultures as superficial, obscuring uniformity of structures and even content. Relativists counter that cultural similarities in surface behavior can likewise obscure diversity in the meanings behind actions. LeVine argues that modern ethnographic studies have revealed more cultural variation than virtually any anthropologist would have anticipated 50 years ago.

Cultural Socialization. Based on ethnographic studies of communication in rural U.S. communities, Heath (1983) reached several conclusions concerning language socialization. The factors involved in preparing children for school-oriented, mainstream success are deeper than differences in formal structures of language or amount of parent-child interaction. Also, patterns of language usage are in accord with and mutually reinforce other cultural patterns, such as space/time orderings, problem-solving techniques, group loyalties, and preferred recreation patterns. In each community, space/time usage and the role of the individual condition the interactional rules for language utilization. The boundaries of the physical and social community and the extent of interactions influence practices including even, for example, the relative degree to which babies are talked to and talked about.

Through the process of socialization, individuals find achieving cultural goals and following cultural norms to be motivationally satisfying (D'Andrade, 1984). Two major intrinsic motivational systems appear to be involved with cultural meaning systems, in the view of D'Andrade. One is relatively direct personal reward. The other is reward due to attachment to a particular set of values. Usually the two systems are intertwined. For example, in "success", accomplishment may be rewarding both because it satisfies personal needs for recognition, achievement, and security, and because it represents the "desired" self. Social sanctions, pressure for conformity, direct reward, and values, all act together to give cultural meaning systems their normative and directive force. In pursuing "success" there are external sanctions involving money and employment, conformity pressures of many kinds, and the direct personal rewards and values already mentioned.

Cross-cultural studies of thinking carry some clear implications for the definition of fundamental skills. These studies indicate there are different ways of categorizing ideas and things, and the categories are largely products of social learning. The acquisition of the culturally-defined classification schemes can be considered a fundamental skill. Contemporary definitions of culture focus on sets of contexts leading to shared meaning systems. These cultural meaning systems provide a view of the world which has implications for the skills emphasized by any cultural group. Language is a cultural symbol system and the particular structure and usage of language influences thinking and reinforces cultural values.

A similar, sociological approach to that of cultural relativism views cognitive activity as socially defined, interpreted, and supported. The social context (Vygotsky,

1978) provides tools for cognitive activity (e.g., math and writing), and conventions that facilitate solutions to problems (e.g., mnemonic devices, numbering and coding systems, scripts). These cultural products are transmitted to novices through social interaction with experienced individuals.

The study of the individual in society is the domain of micro-sociology. The process of socialization is one of internalization of social reality within the individual. According to Berger (1963), "society not only controls our movements, but shapes our identity, our thought and our emotions." Although the reality within which people conduct their lives is largely of their own construction (Berger & Luckmann, 1967), this construction is thought to occur through social processes described by: (1) role theory, (2) the sociology of knowledge, (3) reference group theory, and (4) symbolic interactionism. These processes are discussed in the following paragraphs.

Role Theory. A role, or persona, can be defined as a typified response to a typified expectation (Berger & Luckmann, 1967). Each individual plays multiple roles determined demographically, occupationally, or socially. Position allocated on the basis of what a person is (in terms of age, sex, family relationship) is "ascribed" status, while positions based on what a person can do are "achieved" status. Over time, contrasting or complementary roles may be successively assumed. One can go from student to teacher, from child to parent, from secretary to boss, from guest to host, etc.

A person's self-image is molded by the roles assumed and the reactions of others to these roles (Turner, 1988). Also, the groups to which a person belongs serve as a significant frame of reference for the formation of self-image. The simultaneous occupation of positions with incompatible role requirements is termed "role conflict." Two roles may make conflicting demands on one's loyalties (e.g., the elected official who has business interests may find voting difficult on related bills due to nonlegislative values). Also, two roles may make demands which are incompatible (e.g., a factory foreman may feel pressure from supervisors to act in an authoritarian fashion, while the members of the work crew desire a more permissive atmosphere).

Reference Group Theory. How such roles and group influences are reconciled is the subject of another social factor which shapes identity and thought, i.e., reference groups. The term "reference group" was coined and defined by Hyman (Hyman & Singer, 1968) as a group which someone employs as a basis of comparison for self-appraisal. Two functional types of reference group are distinguishable (Merton, 1957), the normative and the comparative. The normative type sets and maintains standards for the individual, serving as a source of values assimilated. The comparative type serves as a standard of comparison to which the individual evaluates the self and others.

Significant variation exists in the degree of generality with which groups serve as frames of reference. Like role models, reference groups can operate in terms of specific kinds of evaluations and behaviors, where other reference groups can have a pervasive influence. A person will employ a variety of reference groups at different times, and the particular group or individual referred to at any given time will depend on numerous factors. As an example, studies of voting behavior indicate that one's direct associates tend to mediate the influence of the larger social environment. In this way, the norms of the social entity tend to be viewed through the filter of those with whom one interacts directly. When no consensus exists among one's direct associates, the normative orientation of the larger social entity becomes more influential.

Sociology of Knowledge. A third social factor shaping identity and thought is ideology and language. The social location of ideas and reality is the subject of the sociology of knowledge (Berger & Luckmann, 1967). Society supplies our values, logic, information, and misinformation that combine to make up our knowledge. This socially-determined world view has as its foundation cultural definitions of basic concepts such as time, space, and number (Berger, 1963). Some languages do not have, for example, a future tense, but might have several different words for key cultural items such as rice or snow. The language used by a society predefines the fundamental symbolic tools such as words with which individuals comprehend and interpret external and internal reality.

Symbolic Interactionism. The final social factor shaping identity and thought is symbolic interactionism. Several distinct theories of symbolic interaction exist. The term was coined by Blumer (1969). In Blumer's view, symbolic interactionism rests on three premises:

1. Human beings act toward things on the basis of the meanings that the things have for them.

2. The meaning of things is derived from, or arises out of, the social interaction that one has with others.

3. These meanings are handled in, and modified through, an interpretive process used by the person in dealing with the things he or she encounters.

Symbolic interactionism differs from conventional sociological and psychological views of meaning. It does not regard meaning as emanating from the intrinsic makeup of the thing itself, nor does it see meaning as resulting from psychological elements in the person. Rather, symbolic interactionism sees meaning as arising in the process of interaction between people (Blumer, 1969). Therefore, reality, as we know it and deal with it, is social in nature, not a construct of individual percepts and cognitive machinations. Additionally, social reality is said to be "negotiated", that is, the product of ongoing interactive processes. The processes may take a variety of forms, such as conflict, competition, or cooperation.

These processes involve communication with shared and socially acquired verbal and nonverbal symbols (Mead, 1934). All human interaction is based on use of these symbols and the meanings we attach to them. Symbolic interactionists also propose that the "self" we all take as uniquely us is socially defined, and that we are constantly using "significant others" to act as looking glasses which provide feedback for us on the meaning of our behavior. Actually, we do this by imagining the viewpoint of others in our minds, that is, by looking at ourselves as we think others view us (Cooley, 1922).

This concept relates very well to the social psychological theory of social learning (Bandura, 1977) which states that learning occurs through observation of role models who are rewarded for particular responses, as well as through traditional S-R methods. As an example, children learn appropriate responses by observing the outcomes of their parents behavior, and do not have to perform the behavior themselves to learn. Further, the learner acquires expectancies about behavioral outcomes and the kinds of behaviors which are appropriate in a given contextual setting by observing the behaviors of high-status models. Social learning highlights the importance of a models' behavior in influencing the behaviors of others.

Pragmatic Applications of Social Cognition. Cognition can also be viewed as a practical activity which adapts to meet workplace or other situational demands (Scribner, 1984; Lave, 1988). Sociological, anthropological, and linguistic studies have begun to identify new and changing fundamental skills in the workplace. These new skills are not easy to articulate. For example, there is evidence that, as a result of new social and technological changes, some work is being deskilled. Other evidence suggests that skills are being upgraded (e.g., Wallace & Kalleberg, 1982; Spenner, 1989; Kelly, 1990). Sometimes the pattern of changing skill mixes is apparent within an individual's job, with some parts of the job being deskilled while other parts require a higher skill level. In addition, team work skills have appeared increasingly as critical fundamental skills.

Heath (1983) found textile workers had developed intricate social and teamwork processes to deal with increasing job demands. Memos would be reviewed by several workers, each of whom would comment, add background information, and speculate on best courses of action. The individual soliciting responses would use the combination of information gathered to decide on appropriate actions. Fingeret (1983) has found similar patterns of adult low-literates multiplying effectiveness by developing social networks using the expertise of different individuals for different tasks. Additionally, Mikulecky (1982) found that workers on the job formulated questions of each other twice as often as did students in schools. These results suggest that knowing how to use the social structure effectively is a useful job skill.

Surveys of employers conducted by the American Society for Performance and Development (Carnevale, et al., 1989) and by the Michigan Employability Skills Task Force (Pestillo & Yokich, 1988) (Table 2) have listed a range of personal management and teamwork skills which they consider fundamental to job performance. Among

the social skills found important are communicating with group members, being a leader or follower depending upon what is necessary to get the job done, and exercising "give and take" to achieve group results. The use of these skills is never in isolation. It always involves being able to share key background information and often involves being able to use other skills to access key information from documents, charts, diagrams, blueprints, or computer screens.

More recently, Heath (1991) has begun to document and categorize the effective use of written and oral language in teams and groups. She finds that effective individuals are able to negotiate with others by using linguistic conditionals (if-then language and future scenario setting) to create opportunities for group members to consider alternatives. Comparable linguistic structures, and perhaps fundamental skills, have been identified when effective group members: (a) use oral and written language to reflect on current situations; (b) check observations against written graphic, or internalized rules; and (c) move among various knowledge sources (written, personal experience, second-hand information) to solve problems. While work performed by Carnevale and others has identified team work as a critical fundamental skill, Heath's work suggests ways for understanding the strategies actually used by effective team members.

Mikulecky (1991) described the interconnectedness of social and cognitive skills in quality control and self management teams. An electronic switch manufacturer had implemented twice-weekly team meetings and a quality control procedure which involved each of the 6-10 individuals responsible for producing a particular microswitch. During the meetings, team discussions were used to develop a diagram of the steps of production. Through a give-and-take process, team members identified the causes and effects of actions that decreased or increased the speed and quality of task completion. Team members wrote these observations on index cards and added them to the diagram. Between meetings and at subsequent meetings, members read and considered the diagram and cards and added new information and observations using additional cards. While the process produced substantial increases in quality for some teams, it was not uniformly successful. More than 20% of team members, all of whom were high school graduates, encountered difficulty reading and writing the index cards. Others had little experience and competence in working orally with teams. Lack of these skills subverted the process for many teams.

According to Hirschhorn (1984), the post-industrial worker operates at the boundary between older technical realities and emergent ones. In the high technology environment, learning ability becomes more important than past training, and workers' tacit knowledge of a particular machine system becomes more important than general knowledge. Workers must increasingly rely on informal learning and the ability to deal with the unpredictable. This informal learning is likely to call for mixes of social and cognitive skills new to many workers.

Table 2. Michigan Employability Skills Profile

Three Categories of Skills will be required of Michigan workers in the future:

Academic Skills	Personal Management Skills	Team Work Skills
(Those skills which provide the basic foundation necessary for a person to get, keep, and progress on a job)	*(Those skills related to developing the attitude and behaviors required to get, keep, and progress on a job)*	*(Those skills needed to work well with others on a job)*
Michigan Employers Want A Person Who Can:	***Michigan Employers Want A Person Who Can:***	***Michigan Employers Want A Person Who Can:***
• Understand spoken language and speak in the language in which business is conducted. • Read written materials (including graphics, charts and displays) • Write in the language in which business is conducted. • Understand and solve problems involving basic arithematic and use the results. • Use the tools and equipment necessary to get a job done. • Access and use specialized knowledge when necessary (e.g., the sciences or skilled trades) to get a job done. • Think and act logically by using the steps of the Scientific Method (i.e., identify problems, collect information, form opinions and draw conclusions).	• Identify personal job-related interests, strengths, options and opportunities. • Demonstrate personal values and ethics in the workplace (e.g., honesty, fairness, and respect for others). • Exercise a sense of responsibility. • Demonstrate self-control. • Show pride in one's work • Be enthusiastic about the work to be done. • Follow written or verbal directions. • Learn new skills and ways of doing things. • Identify and suggest new ideas for getting a job done. • Be a leader or a follower depending upon what is necessary to get a job done.	• Identify with the goals, norms, values, customs and culture of a group. • Communicate with all members of a group. • Show sensitivity to the thoughts and opinions of others in a group. • Use a team approach to identify problems and devises solutions to get a job done. • Exercise "give and take" to achieve group results. • Function in changing work settings and in changing groups. • Determine when to be a leader or a follower depending upon what is necessary to get a job done. • Show sensitivity to the needs of women and ethic and racial minorities. • Be loyal to a group.

Textbook knowledge of production systems is taught analytically. The operator learns to reason from underlying causes (e.g., a fractured pipe) to overt symptoms (e.g., blocked circulation). In operating complex systems, however, the requirement is reversed: the worker must reason from symptoms to any of several possible causes. Diagnosing symptoms requires synthetic reasoning, in which the range of possible causes is narrowed as more information is received. This process is not linear but cyclical. Synthetic reasoning is more difficult than analytical reasoning. There is no abstract thread of connections to follow. Instead, the worker must determine what kind of problem exists and which information is relevant. This diagnostic skill depends on an ability to frame problems, infer causes from symptoms, and check resulting hypotheses against analytical knowledge.

What is the basis for this type of skill? According to Hirschhorn (1984) it is context-specific knowledge and the ability to learn. Each time operators are required to diagnose a novel problem, they must depend on their existing knowledge base. However, they also must become learners, working to reconstruct and reconfigure that knowledge base appropriately. To develop skill at learning, they must learn to learn. In this sense, the diagnostic process may be regarded as extending workers' skills rather than reducing them.

Summary

In this section we have described some of the prevailing theoretical orientations for defining functional skills. These orientations were treated as atheoretical and theoretical. Concerning the definition and training of fundamental skills, major points of this section were as follows:

1. Atheoretical approaches have resulted in fundamental skills being defined without clear rationale. As a result, several competencies and attributes have been labeled as basic, or fundamental, skills without any apparent justification, and evidence supporting their requirements on the job is lacking. However, regardless of how they are defined, competencies which are repeatedly listed by workforce members as essential for success should not be rejected by the Air Force without some further scientific examination.

2. Fundamental skills training programs have tended to focus on literacy skills alone, and they have varied significantly in the degree to which they relate to the job. Further, the traditional theoretical approach to training has been behaviorally oriented. This orientation has led to the development of a number of "generic" programs which have not been very successful.

3. Current psychological approaches reflect at least two strong tendencies: one is the tendency to move away from generic instruction that is situated in the job context; the other is the tendency to view fundamental skills as including a far larger set of skills than literacy skills (i.e., reading and arithmetic) alone. Cognitive theorist views that learning is a process of knowledge construction; that learning depends heavily on the use of existing knowledge; and, that learning is most effective when skills are practiced in the environment in which they are used, appear to have played a major role toward shaping thinking in the area. Among current orientations to fundamental skills training, the functional context approach must be regarded as primary in its emphasis on the need to situate learning in the using context.

4. Sociological, anthropological, and linguistic studies have begun to identify new and changing fundamental skills in the workplace. These skills include knowing how to access information and perform within groups and learning to learn (e.g., informal learning). Cross-cultural studies indicate there are different ways of categorizing ideas and things, and the categories are largely

products of social learning. The acquisition of the culturally-defined classification schemes can be considered a fundamental skill.

5. The development of skills occurs within a particular social/cultural context in which they are valued. Thus, theories concerning how and why learning occurs through social interaction are important when considering how skills are acquired or modified. As an example, the theory of symbolic interactionism proposes that all meaning or psychological reality is based in the process of interaction between people, and that we need feedback from "significant others" to determine the meaning of our behavior (e.g., social learning). These theories highlight the importance of identifying and using appropriate role models for skill training.

6. In a high technology environment, such as the current and future AF, workers must increasingly rely on informal learning and the ability to deal with the unpredictable, (e.g., diagnostic trouble-shooting). According to some theorists, the basis for this type of skill is context-specific knowledge and the ability to learn. Thus, knowing how to learn in order to rapidly acquire these new technical skills becomes an important fundamental skill.

Several conclusions can be drawn from our review of the conceptual orientations which could influence the structure of future AF fundamental skills training, including the following:

1. Where possible, training should be designed to build upon and complement the trainees existing knowledge base and previous experiences. In addition to initial learning, this is also important to maximize transfer of learning to the performance of new tasks as technology changes drive changes in future job requirements.

2. Training materials, and possibly the training itself, should be closely aligned and coordinated ("situated") with the work context. An additional benefit of this approach is a reduction in dedicated training time, as the trainee enhances fundamental skills while concurrently learning more job specific skills.

3. Increases in the complexity of future jobs will require workers to constantly learn how to solve new problems and adjust to changing workplace requirements. This would suggest that learning how to learn and adaptability will become increasingly important fundamental skills and research should be conducted on how best to teach these skills.

4. The impact of "significant others" and high status role models on human learning may dictate the requirement for more training in a social, group-paced context. If being able to function effectively as a team member is an important fundamental skill, it would be very difficult to teach this skill in an

individual context. Further, the role model selected for the training must be perceived of as a "significant other" in order for the feedback to be meaningful.

5. For the Air Force to be fully successful in integrating people from diverse cultural groups, it may have to provide training to the current workforce as well as new recruits. This type of training should encompass not only diversity and cultural awareness, but how and why people with different cultural perspectives develop and maintain different learning styles and motivational sources.

The identification of fundamental skills is context dependent. Therefore, the identification of AF requirements for these skills must begin in the training or work context. In the remaining sections of this paper, we discuss and evaluate job analysis methods of determining these requirements at different AF classification levels. We also present criteria for evaluating the methods, and a recommended approach.

IV. CONSIDERATIONS IN SELECTING A FUNDAMENTAL SKILLS DATA COLLECTION AND ANALYSIS METHOD

The identification of fundamental skills requirements must be based upon an understanding of the actual behaviors and behavioral requirements of jobs. This understanding of human behavior, and its related behavioral requirements, may be addressed from several perspectives. The following discussion addresses conceptual parameters and considerations that will help focus this report's review and evaluation of methods for identifying fundamental skills requirements. It will address: (1) The role of scientific disciplines in skills identification, (2) Job analysis as the methodology for fundamental skills identification, (3) Parameters in defining a job analysis methodology, and, (4) Criteria for evaluating the methodologies.

Scientific Disciplines and the Identification of Fundamental Skills

The particular scientific background and perspective of a researcher may influence the approach and orientation that is taken in the identification of fundamental skills. Therefore, it would be useful to begin our discussion of methodological considerations with a review of the analytic techniques and perspectives employed within the different scientific disciplines.

As mentioned previously in this paper, there are primarily three scientific disciplines concerned with human behavior: (1) Cultural anthropology; (2) sociology; and (3) psychology. Each discipline has a slightly different emphasis on the nature of variables that shape and drive behavior, as well as different preferred data

collection techniques. The following paragraphs provide a summary of these differences in relation to fundamental skills.

Cultural Anthropology, using methods/approaches such as ethnography, focuses on identifying and describing the model or typical behavior within a cultural group. It commonly addresses the symbolic systems of a culture that shape behavior. The anthropologist usually investigates culture by immersing, living, and participating in a culture for an extended period. The researcher uses observation and interview techniques over a period of several days or weeks to several years.

The analysis of the cultural group typically focuses on symbolic systems that are culturally based and that shape behavior. This includes such things as language, kinship, religion, and child development and maturation practices. Attention is placed on describing modal behavior within a culture; the typical or culturally expected behavior in a particular situation.

The anthropological perspective does not customarily focus on the identification of different skill levels within a particular culture. Rather, this perspective is helpful in understanding why certain fundamental skills may be differentially developed within different cultural groups. For example, this perspective may help in addressing questions such as, "How and why Asian cultures place a greater emphasis on the development of numerical/math skills (if they do) than do Western cultures?" This perspective provides insight regarding: (1) The understanding of cultural diversity and its potential link to different skills levels in different cultural groups, and (2) an understanding of culturally oriented skills.

Sociology studies the statics and dynamics of individual and group interaction as well as the forms and change processes in major social institutions, societies, and world systems. The sociologist usually investigates social behavior by observation, experimention, interviews, and questionnaires. Questionnaires supplement the observation and interview process by permitting the collection of information from representative cross sections of group members.

The analysis typically focuses on symbolic systems that are common to a social group and that shape behavior. This includes considering such constructs as social role, reference groups, symbolic interaction, interactional dynamics and social cognition. Attention is placed on describing the social context that may evoke a particular behavior. Reference is made to social norms, that is, the normal or typical behavior expected in a particular situation. The sociological perspective does not typically assess differences in behavior as skills within a particular social role. Rather, this perspective is helpful in understanding why certain skills may be differentially developed within different social groups. For example, the sociological perspective may help in addressing questions such as, "How and why suburbanites may have greater opportunities to develop leadership skills than do inner city or farm youth?"

The sociological perspective provides insight regarding: (1) the understanding of social diversity and its potential link to different skill levels manifest in different social groups, and (2) an understanding of certain potential skills such as those involving group participation and leadership.

Psychology focuses on identifying and describing the behavior of individuals with an emphasis on those characteristics within individuals that influence behavior. The psychologist usually investigates individual behavior by techniques including observation, interviews, and assessment devices. The assessment devices may include such things as: (1) tests of individuals, such as intellectual efficiency and cognitive capability; (2) assessments of individual values, interests, preferences, and needs; and (3) assessments of the environment in which individuals must exhibit certain behaviors.

The analytical approach of psychologists typically focuses on the unique characteristics of individuals, frequently called individual differences, that shape behavior. This includes considering such factors as psychopathology, intellectual ability, and learned skills and knowledges. A focus of the psychological approach is on the development of measurement tools for the components of behavior. This includes the development of instruments for assessing intelligence, abilities, skills, values, interests, attitudes and needs. Attention is placed on describing or predicting the type of behavior or level of performance of individuals. The psychological approach addresses such issues as, "What knowledge, skills and abilities are necessary to be a business/government executive? Who possesses these skills? How are they developed?"

The psychological perspective provides a key approach for identifying and measuring fundamental skills. There are two reasons for this: (1) the psychological perspective identifies and diagnoses skills and skill levels within individuals, and (2) it has developed analytical techniques that are specifically targeted at identifying skill requirements within occupational areas.

Each of the various disciplinary perspectives provide unique and valuable approaches for identifying and measuring fundamental skills. The psychological approach provides methods and tools for identifying individual characteristics and relating these characteristics to job requirements. The anthropological and sociological perspectives compliment this approach by providing insight into how and why skills are developed within different contexts, and how they are related to group processes and cultural diversity. These different perspectives influence the choice of data collection methods and approaches discussed in the following paragraphs.

Job Analysis - The Methodology for Identifying Fundamental Skill Requirements

As defined earlier in this paper, fundamental skills are the foundation behaviors required in the majority of AF jobs. Accordingly, the identification of fundamental

skill requirements must be based on an understanding of the nature and requirements of these jobs. This understanding is provided by a methodology and process known as job analysis.

Job analysis, broadly defined, is the collection and analysis of any type of job-related information by any method for any purpose (Tiffin & McCormick, 1965). Effectively, it is the process of gathering information about jobs, analyzing this information, and documenting it in some way. There are a number of different approaches, data collection techniques, and methods which can be used singularly or in combination to conduct a job analysis. Most of these methods have been described in an excellent recent publication edited by Sidney Gael, (1988). Job analysis methods that we evaluated for their potential application for determining fundamental skills requirements are presented in Appendix C. Results of the evaluations are discussed in the next section of this paper.

Parameters in Defining a Job Analysis Methodology

There is no "best method" of job analysis for every application as there are several parameters that affect the nature and forms of a particular job analysis process. Page and Van De Voort (1989) identify five categories of these parameters, which are presented in Table 3. A brief discussion of these parameters follows.

First, the purpose of the job analysis may influence the nature, emphasis, and format of a particular job analysis methodology. Table 3 lists seven of the most common purposes. Of these, the ones having more direct application to AF fundamental skills applications include recruitment and selection, human resources planning, and training needs identification. In the area of training needs identification, the Air Force commonly refers to its job analysis methodology as task analysis. The focus is on training to specific tasks performed on the job, which are expressed as observable actions or overt behaviors.

The second parameter in Table 3 is the type of information that is collected by the job analysis methodology. The application of Job Design, Compensation and Pay Equity, and Performance Management, as well as Training Needs Identification, are fundamentally concerned with job content and, to a lesser degree, job context. The application of Recruitment, Selection, Career Planning and Human Resource Planning are fundamentally concerned with job requirements. These are the knowledges, skills, abilities and personal characteristics, collectively referred to as human attributes, that are required for effective job performance. The Air Force, in selecting and advancing airmen, as well as in forecasting future employee requirements, needs to focus on the capabilities that employees must have to perform job requirements effectively. Consequently, fundamental skills identification dictates that the job analysis methodology must effectively address job requirements.

Table 3. Considerations for Selecting Job Analysis Methods

PURPOSE OF JOB ANALYSIS	
I.	1. Job/Organization 2. Recruitment and Selection 3. Compensation and Pay Equity 4. Career Planning 5. Training Needs Identification 6. Human Resource Planning 7. Performance Management
TYPE OF INFORMATION COLLECTED	
II.	1. Job Content (work-oriented behavior, tasks, etc.) 2. Job Requirements (worker-oriented behaviors, KSAs, traits, etc.) 3. Job Context (Supporting information on purpose, setting, discretion, etc. of job) 4. Machines/Equipment Used 5. Critical Incidents
SOURCE OF INFORMATION	
III.	1. Archival Information 2. Incumbent 3. Supervisor 4. Subject Matter Expert 5. Job Analyst 6. Instruments/Machines (i.e., cameras)
METHOD OF INFORMATION COLLECTED	
IV.	1. Observation 2. Interview (individual or group) 3. Reviewing Sample Documents, Work Outputs, Literature 4. Diaries and logs 5. Open-ended Questionnaires 6. Structured Questionnaires 7. Recordings of Work (films, mechanical/electronic tracking, etc.) 8. Participation (job analyst does the job himself)
FORM OF DATA ANALYSIS AND REPORTING	
V.	1. Qualitative (i.e. interview) 2. Quantitative (i.e. questionnaire)

The third parameter is the source of the job analysis information. In most approaches used today, the best sources include job incumbents, supervisors, and subject matter experts.

The fourth parameter is the method of data collection. These may include relatively unstructured and probing techniques such as participant observation or interview. The choice of a particular method may depend on the purpose of the job analysis, the type of information required, the scope of jobs analyzed, and the availability of information. These issues have a particular impact on organizations of different sizes; small organizations with just a few jobs may find it economical to employ unstructured techniques. In contrast, large organizations may find structured questionnaires to be most effective. Observation, interviews, and participation techniques may be used to develop the job analysis questionnaires. Then the questionnaire may be used with thousands of geographically dispersed employees within a very short time.

The final parameter addressed in Table 3 is the form of data analysis and reporting. There are essentially two forms: qualitative and quantative. Qualitative forms are used with the unstructured and open-ended techniques. The information may be consolidated and formatted for position/job description or lists

of training requirements. Quantitative approaches are becoming more prevalent with the ever increasing use of computers, especially micro computers.

Criteria for Evaluating and Prioritizing Job Analysis Methods for Air Force Application

The previous discussion revealed there are several parameters and issues that affect the particular format of a job analysis methodology for a particular application. Consequently, to identify a relevant job analysis methodology, we must have a clear picture as to the objectives related to the job analysis output and implementation process. We next discuss some background issues regarding the selection of a particular job analysis method, provide examples of these methods, and present ten recommended criteria for evaluating the appropriateness of job analysis methods for AF fundamental skills application.

Background Issues

The primary method of job analysis that has been employed by the Air Force has been the task inventory approach. This is commonly referred to by the name of the data analysis package used with this approach, the Comprehensive Occupational Data Analysis Program, or CODAP. It has been used for approximately the past 25 years for identifying tasks performed on jobs so that training systems can be developed which train to the performance of actual, job-related tasks. The identification of fundamental skills has, fundamentally, a different emphasis. Rather than identifying the tasks that are performed, the analysis must identify the worker requirements of jobs. McCormick (1979) described this distinction by defining two fundamental approaches to job analysis: work-oriented and worker-oriented approaches.

Work-oriented approaches describe what gets done on the job. This includes the duties, activities and tasks of the job. The focus of work-oriented approaches is on job outputs using action verbs and what gets done, with a focus on results or work products. In contrast, worker-oriented approaches are concerned with basic human behaviors required to perform a job activity. The focus is essentially on job requirements, the knowledge, skills, abilities, and personal characteristics required to perform the job. Accordingly, it identifies what people exhibit as they are performing the job.

McCormick indicates that worker-oriented elements are more generic than work-oriented elements. They relate to the knowledge, skill, and ability levels of workers and cut across a wide spectrum of jobs. Consequently, worker-oriented approaches will tend to better identify job knowledge and skill requirements and will do this in a more parsimonious format. Other background issues which should be considered concern the relation between theoretical orientations that were previously mentioned in this report, and their effect on skills identification. The following paragraphs address these issues.

Functional skills dealing with personal interaction (including social and communication skills) and management (including resource and information management skills) cannot be adequately described or understood using work-oriented survey methods of analysis. Problems with surveys of incumbents and subject-matter-experts (SMEs) involve a surface and isolated task focus, and the related tendencies to emphasize simple, conscious processes and individual tasks. Surface behavioral tasks dominate surveys to the extent that more complex cognitive and other covert mental processes are not usually referenced, and are rarely described in any detail. Isolated, or generic, tasks have been abstracted from the job and other environmental contexts. This ignores the importance of situated and functional aspects of the work contexts which influences skill performance. Also, even experts are not necessarily good at verbalizing the processes involved in decision-making and other complex cognitive functioning. The tendency is to report conscious, well-known activities, and omit subconscious higher-level and automatic processes. Similarly, individual raters tend to focus on individual tasks, and ignore shared or team tasks (RCA Service Company, 1984).

The functional context approach, discussed earlier in this paper, when applied to skills identification, emphasizes meaningfulness and motivation. Appropriate theoretical approaches to personal interaction and management skills are symbolic interactionism and social-learning theory which also emphasize meaning and motivation. Martinko and Gardner (1984) have used social learning theory as a model to guide data collection and analysis in a management skill study. This model emphasizes the importance of the environment (context), cognitive processes, and the interactive (social) nature of behavior.

The overall implication of these background issues is that in the selection or development of a job analysis methodology, the Air Force needs to be sensitive to approaches that help identify worker-oriented behaviors and that assess non-observable characteristics of workers. These issues have been taken into account in the definition of our criteria for evaluating job analysis methods for AF application.

Application of the Methods

Current government sponsored programs which focus on the identification/training of fundamental skills have used a variety of methods to determine skill requirements. The following programs are presented as examples of the methodological approaches. A more complete description of the military service programs we reviewed for this paper is presented in Appendix D.

ISEP. The Army has a long tradition of teaching basic skills to help close the gap between job demands and individual proficiency in skills. However, a 1983 evaluation by the General Accounting Office (GAO) concluded that the programs, which focused on general, academic skills, were not effective in alleviating deficiencies in basic skills. Recommendations of the GAO included

defining/identifying basic skills required for each military job, and determining whether the desired skills were attainable. Subsequently, JSEP was developed by the Army (Farr & Ward, 1988). JSEP is a computer-based, self-paced instructional program that was built on an analysis of academic skills related to performance of tasks in 94 military occupational specialties (MOSs).

The skills analyses, undertaken initially to revise the Basic Skills Education Program (BSEP), were accomplished via contract with RCA Service Company. The primary objectives were to identify and functionally tie prerequisite competencies and basic skills to MOS performance requirements through a task analysis process labelled the Extended Task Analysis Procedure (ETAP), and to facilitate the diagnosing and prescription of needed remedial training for identified prerequisite competencies and basic skills through the development of skill profiles and diagnostic tests. ETAP is defined as "a comprehensive approach to task analysis with provisions for action and hierarchical analysis and knowledge analysis" (RCA Service Company, 1984). In this process, tasks are procedural (action) statements contained in Soldier's Manuals or task lists for each of the 94 MOSs.

The ETAP combines hierarchical task analysis and information processing analysis with other techniques to identify prerequisite skills for performing identified tasks (Reigeluth, Merril, Branson, Begland, & Tarr 1980). The procedures are combined with several action and decision steps to form three general task analysis methods: (1) procedural analysis, (2) principle transfer analysis, and (3) factor - transfer analysis. The last step in the analysis process is a review of the results by an experienced instructor to identify required concepts, facts, and principles required for tasks completion that are being taught in a training course. Those skills and knowledges which have been identified by the analysis as required, but are not being taught, are then listed as prerequisite skills which must be taught in fundamental skills training. This analysis formed the basis for the computer-based JSEP courses then being developed at Florida State University (Rayner, Darabi, & Farr, 1985).

An integral part of the ETAP is the information gathered by interviews of Subject Matter Experts (SMEs) by a trained analyst. These interviews were often argumented by the analyst observation of training, or SME demonstrations of portions of the task. A total of 1,443 SMEs were interviewed as part of the effort. Although RCA was able to identify prerequisite competencies and basic skills through the ETAP methodology, they were not able to adequately determine if the skills were being taught in training due to a "limitation of resources." Thus, it is difficult for us to see how they derived training requirements solely from the ETAP process. None the less, the analysis did result in a taxonomy listing more than 200 prerequisite competencies for the 94 MOSs. Prerequisite competency was defined by RCA as a generic basic skill that soldiers must have in order to learn specific tasks on their skill level 1 and 2 jobs (Rayner, Wilson & Farr, 1985).

The taxonomy of 200 skills (prerequisite competencies) produced includes not only fundamental verbal and quantitative skills, but also such skills as identifying the meaning of symbols on a flow chart, and organizing information from multiple sources. The skills, or competencies, are grouped into a taxonomy of 41 sets, or series. Each set can be considered a higher level, or category of skill. A list of these sets of skills is in Appendix B. The curriculum includes 180 short, diagnostic review lessons presented by computer in a military or technical context. The particular sequence of training for each student is a function of the "prescription" of skill activity requirements for his or her MOS, and their performance on the diagnostic tests.

A potential concern related to JSEP is the general lack of evaluative data demonstrating its effectiveness. This is not to deny the potential applicability of the program to a wide variety of performance contexts, or to suggest that the program may not be effective, only to indicate that evidence attesting to this effectiveness is limited. A greater concern for the Air Force when evaluating the JSEP methodology for its own use is the resources required to conduct an ETAP type analysis, which was by itself a multi-million dollar component of the total program (personal communication, B. Farr, Oct.,1991). Further, the RCA analysis did not include collecting data from the field concerning total requirements of the various MOSs (although individual SMEs participated in the ETAP analysis), nor did they observe the tasks being actually accomplished on the job as part of the analysis process.

It would appear that a more efficient approach for the Air Force to employ, which would yield equally valuable data concerning job requirements, would be a structured interview/survey method which could provide an abundant amount of data, for comparatively low cost, from respondents who are in the best position to identify requirements - current job incumbents and supervisors. This method would also allow for input from the field to initially identify the skill requirements, rather than being solely dependant on task descriptions provided in available documents. This input from first-hand participants could provide an expanded and worthwhile perspective concerning the total range and types of skills required to work with others successfully in a given work context.

SCANS. The SCANS charter was to identify and recommend the necessary skills for work readiness required to better prepare youth to enter the work force of the future. SCANS has identified a set of 21 workplace skills and competencies regarded as essential for high school graduates to gain meaningful employment now and in the future. The 16 foundation skills identified by the SCANS were presented in Section 2 (Table 1). The five competencies identified are presented in Table 4 (U.S. Department of Labor, 1991).

The process of identifying and defining these skills and competencies was conducted in four stages. The first stage consisted of establishing a methodology for the research. Suggestions, opinions, interviews, reviews of recent research and on-site visits were employed. The preliminary data were refined by a panel of experts

until it satisfactorily described the important aspects of what people do at work. Second, an extensive literature review of psychological, educational, and business data bases was conducted to define the skills that resulted from the experts' prior meeting. Third, experts reviewed the skills and the definitions for accuracy and completeness. Fourth, a job analysis was conducted to determine how these skills are used in the workplace. The data collected from this analysis was used to evaluate the adequacy of the SCANS foundation skills and competency definitions and to assist in establishing methods for assessing and training skills.

Table 4. U.S. Department of Labor (1991) SCANS Competencies

FIVE COMPETENCIES

Resources: Identifies, organizes, plans, and allocates resources

A. *Time* - Selects goal-relevant activities, ranks them, allocates time, and prepares and follows schedules

B. *Money* - Uses or prepares budgets, makes forecasts, keeps records, and makes adjustments to meet objectives

C. *Material Facilities* - Acquires, stores, allocates, and uses materials or space efficiently

D. *Human Resources* - Assesses skills and distributes work accordingly, evaluates performance and provides feedback

Interpersonal: Works with others

A. *Participates as Member of a Team* - Contributes to group efforts

B. *Teaches others new skills*

C. *Serves Clients/Customers* - Works to satisfy customers' expectations

D. *Exercises Leadership* - Communicates ideas to justify position, persuades and convinces others, responsibly challenges existing procedures and policies

E. *Negotiates* - Works toward agreements involving exchange of resources, resolves divergent interests

F. *Works with Diversity* - Works well with men and women from diverse backgrounds

Information: Acquires and Uses Information

A. *Acquires and Evaluates Information*

B. *Organizes and Maintains Information*

C. *Interprets and Communicates Information*

D. *Uses Computers to Process Information*

Systems: Understands complex inter-relationships

A. *Understands Systems* - Knows how social, organizational, and technological systems work and operates effectively with them

B. *Monitors and Corrects Performance* - Distinguishes trends, predicts impacts on system operations, diagnoses deviations in systems' performance and corrects malfunctions

C. *Improves or Designs Systems* - Suggests modifications to existing systems and develops new or alternate systems to improve performance

Technology: Works with a variety of technologies

A. *Selects Technology* - Chooses procedures, tools or equipment including computers and related technologies

B. *Applies Technology to Task* - Understands overall intent and proper procedures for set-up and operation of equipment

C. *Maintains and Troubleshoots Equipment* - Prevents, identifies, or solves problems with equipment, including computers and other technologies

For Phase I of the job analysis, 15 jobs were analyzed through interviews with job incumbents or their supervisors. Job experts were asked to review the clarity of the 36 skills definitions and to rate each skill in terms of its criticality to the job being analyzed. For fundamental skills that were rated as highly critical, interviewees were asked to describe a task that required the use of the rated skill. In addition, job experts were asked about critical incidents that described the proficient use of skills and also to discuss an exceptional day that required the use of the skills. The latter procedures provided a job-related context within which the skills were used.

It should be noted that the SCANS skills list is vulnerable to the same dangers which have rendered other lists counterproductive. Though actual job situations were surveyed to construct the list, the final product can easily be misconstrued to imply generic, context-free skills with new labels. Further, the labeling of the skills and the creation of categories has an attractive logical appeal to it, but no research has been performed to support the psychological or sociological reality of the SCANS list of 21 skills and competencies. No studies have determined that workers actually employ these skills and processes when performing tasks, and the degree to which these are required or repeatedly used across tasks is unknown.

Our primary criticism of the SCANS approach centers on the way the 21 skills and competencies determined to be fundamental were identified. Use of expert judgement, reviews of the literature, and on-site visits is an appropriate method to devise an initial list of skills which can be used as a starting point for more complete analysis. However, this initial list must be verified by data pertaining to what people are required to do on the job. In addition to verifying this initial list, job analysis data will probably lead to modifications and additions to the list. In any case, the final list should be defined by the results of the job analysis, not by a priori expert opinion. In the case of the SCANS, simply asking the respondents to endorse the initial list and to give examples of how the skills might be used in their respective jobs is insufficient in our opinion.

Job-Oriented Basic Skills (JOBS). In 1978, the Navy implemented the Job-Oriented Basic Skills (JOBS) program to address the widely predicted shortfall of high quality recruits. The JOBS program provided low aptitude recruits with basic or prerequisites skills training needed to complete selected "A" schools (basic technical schools) or BE/E schools (preparatory schools in basic electrical or electronics skills) and to perform to standards in the fleet. JOBS prerequisite skills training covers basic skills such as mathematics and reading which are taught by contractors using traditional classroom methods in four to eight week courses at designated JOBS schools.

The initial identification of the enabling skills required to assist the low aptitude recruits selected for the program was based upon a "concepts oriented" methodology developed by the Naval Personnel Research and Development Center (NPRDC). This methodology focused upon identifying those skills which would enable students to understand the instruction and concepts of "A" school instruction.

(personal communication, M. Baker, October, 1991). A written statement was tailored for the various courses covered by the initial 4 JOBS training areas and a series of questions were developed based upon the statements. The answers were evaluated using a complex algorithim which expressed understanding in mathematical terms.

The methodology was tested on a series of "A" school qualified recruits and on a series of recruits selected for the JOBS program. The results of this test were that the "A" school qualified cohort "understood" and the JOBS program cohort did not understand the concepts. The differences in the responses of the two cohort groups were analyzed and those enabling skills possessed by the "A" school qualified cohort and not present in the JOBS cohort were identified. Repeated trials of this methodology finalized the list of required enabling skills that the JOBS curriculum was required to enhance.

Personnel are selected for JOBS training on the basis of their Armed Services Vocational Aptitude Battery (ASVAB) Composite score. The ASVAB tests that make up the composites and the cutoff scores for admittance to specific "A" schools have varied over time. The ASVAB score requirements for the selection of JOBS candidates have also varied. Scores for those selected for JOBS are below the normal cutoff levels for the schools and have been limited to a 30-point range.

If the sole purpose of an AF fundamental skills program is to train personnel, who would not otherwise qualify, on prerequisite skills required in technical training, the JOBS methodology should be given serious consideration. Despite a significant expansion in the JOBS program, success has been achieved and maintained over a sustained period. However, this approach should only be a component of any future AF program, as skills identified with this method have been linked to training, and not to generic skill requirements for effective job performance. Further, the Air Force is not currently faced with having to accept such a large percentage of low ASVAB scorers. If this situation changes dramatically in the future, the JOBS approach could be a very viable option.

Criteria for Evaluating Job Analysis Methods

Following the issues addressed above, and an analysis of the Air Force objectives for the research, we have identified nine criteria that may be used in evaluating the appropriateness of job analysis methods for AF fundamental skills application.

The first six criteria pertain to the quality and utility of outputs, or results, of the job analysis methodologies. The last three criteria pertain to the feasibility of the process for implementing the method. Each of these criteria are described below.

1. Trainable. The job analysis method should identify knowledge and skill requirements that are trainable. In essence, the units of analysis should be congruent with our definition of fundamental skills.

2. Measurable. The job analysis method should identify knowledge and skills that are ultimately measurable. If they are not measurable on a continuum, it will not be possible to identify the degrees to which they are required for effective job performance and the extent to which individuals possess them.

3. Appropriate Level. The method should identify knowledge and skill requirements at the appropriate level of analysis for the level of jobs being addressed. If career fields are being addressed, knowledge and skills at this level of specificity are needed. If a specialty analysis is being performed, identifying knowledge and skills at this level is needed.

4. Comprehensive. The method should be comprehensive of the domain of work that is being addressed. If a career field level of analysis is being performed, requisite knowledge and skills across all AF career fields should be identified.

5. Valid. The method should be appropriately reliable and valid for AF application. The method, when applied to various groups of employees, should produce similar results. Furthermore, the results of the analysis should accurately reflect job requirements.

6. Linkages. The method should have the capability to link its results to other AF systems and data bases. For example, it is desireable to have a conceptual format by which the fundamental skills identified by the job analysis procedure can be linked to the CODAP task inventory data that has already been collected for AF jobs.

7. Design. The method should not require an unreasonable amount of resources and efforts for the customization of the process for AF application.

8. Use. The method should require an administratively feasible amount of resources and effort for the implementation and use of the system to identify skills requirements.

9. Time/Cost. The method should produce results within a relatively reasonable time-frame and within reasonable overall cost.

An evaluation of the various job analysis methods using these criteria will be presented later in this paper. The next section contains a review of the various methods and approaches to be evaluated.

V. EVALUATION OF JOB ANALYSIS METHODS AT THE AIR FORCE CAREER FIELD AND SPECIALTY LEVEL

In the previous section we presented examples of methodological approaches used in several major fundamental skills programs. We also commented on their potential utility for AF application. In this section we review and discuss issues associated with applying specific job analysis methods at the career field and specialty levels of analysis, then we evaluate and rank order each of these approaches for application at these levels of analysis. We have restricted our discussion and evaluation to those data collection techniques and job analysis methods presented in Appendix C which we consider the most relevant or potentially useful approaches to determining AF fundamental skill requirements. The section concludes with a discussion of the interrelationships of the methods at the different levels of classification.

Background

As noted earlier in this paper, the goal of this effort is to satisfy several objectives, only the first of which is to investigate alternative theoretical orientations for defining fundamental skills. Additional objectives include establishing requirements for fundamental skills at varying levels within the Air Force (i.e., career field, specialty level, and possibly job/task level), and addressing the interrelationship among analytic systems supporting these requirements.

This goal presents several research challenges in consideration of the current AF personnel classification system, and the complexity and diversity of existing requirements determination methods. Approaches for determining requirements at the broad, molar career field level are quite likely to differ from those appropriate to the more differentiated specialty and certainly, component job/tasks levels.

As illustrated in Figure 3, the Air Force classification system is comprised of career fields (e.g., Missile Maintenance) which consist of related specialties, each of which differ by skill levels and individual job/task requirements. Thus, one way of considering career field requirements would be to view them as aggregates of the lower levels (i.e. specialty). Since career fields are aggregates of specialties, this would seem to be a parsimonious and logical approach. However, there are over 230 major enlisted Specialties in the Air Force, and the number of tasks within each specialty may range between 400 and 1,500 (Gould, Archer, Filer, Short & Kavanagh, 1988). Skill requirements and jobs can vary greatly among any given set of career field specialties and their aggregation could result in a broad list of requirements for a field which are only partially relevant to any particular component specialty. Thus, the methodology for determining generic fundamental skill requirements across specialties must be capable of comparing different jobs with many different tasks. To date, little research has been conducted to develop such methodologies.

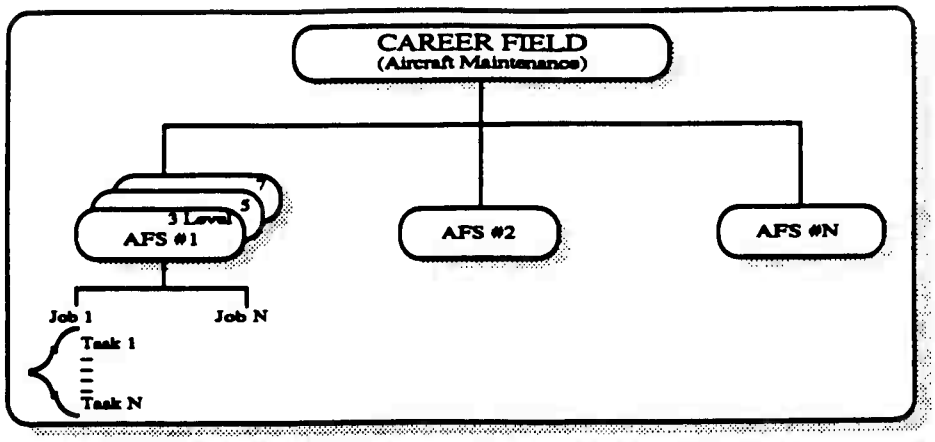

Figure 3. Air Force Personnel Classification Structure

A modification of this composite approach which has received recent research attention involves considering commonalities of specialty skill requirements as reflected by empirically derived clusters of similar skills across the specialty components. These clusters and their associated factor scores are then considered components of "job families" across specialties which, when considered individually, consist of many different job activities. Specialty requirements would then be determined using a classification structure as depicted in Figure 4. This approach is similar to that used recently by Cunningham, Wimpee, and Ballentine (1990) to develop taxonomic descriptors across a large number of Air Force specialties using the General Work Inventory (GWI). In a similar vein, the more molar level field requirements might be considered as aggregates of the associated specialty families.

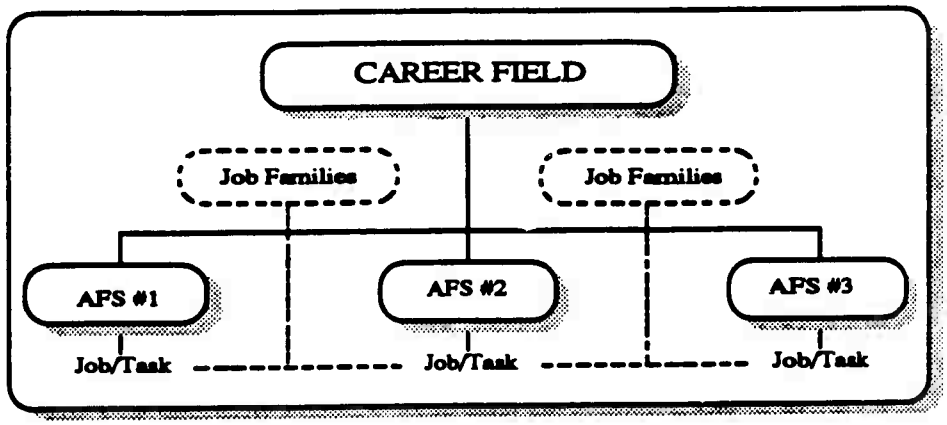

Figure 4. Personnel Classification by Job Family Clusters

A second issue of importance to this research concerns the use of career fields themselves as a unit of analysis. In a sense, asking the question of "what are career field fundamental skill requirements" is akin to asking "what are AF level requirements." The molar concept of "successful career field performance" may

encompass several requisite skills, such as socialization and strategic goal setting, which are not measured by traditional job/task analytic methods. Being successful in your career field means possessing the requisite skills to progress to higher skill and grade levels. The effective use of skills which may well go beyond the performance of discreet job tasks or duties.

Evaluation of the Methods

A number of job analysis methods discussed in the previous section and in Appendix C have application for identifying fundamental skills at the career field and specialty levels. Although none of the methods precisely addresses all of the Air Force needs, a combination of elements from various approaches may meet the objectives. Thus, the following paragraphs will (1) address the relevance of each of the methods for career field and specialty application, (2) address the extent to which the methods can relate skills at one level of analysis to another level of analysis, and (3) address supplemental information needed to identify relationships in skills across levels of analysis.

Observation/Interview

This method is not suitable as the primary method of job analysis because it is too labor intensive. For example, if a job analyst were to spend two days in participant observation for each portion in the Air Force, that would add up to about a million days of job analyst effort if each of the approximately 500,00 employee positions were analyzed. Obviously, the burden of gathering this data and analyzing the result would be too time consuming and costly.

In contrast, these methods would be useful complementary approaches in developing levels of structured questionnaires which could be used to gather the data in a more efficient manner. Observation can be effectively used to help define the elements that appear on the questionnaire. Also, as previously noted, participant observation can be extremely useful in identifying and defining the non-observable worker oriented job elements that may be required for fundamental skills identification. Finally, it can help establish and articulate the linkages between specialty and career field levels of analysis since the job analyst sees the job in whole and can participate in, and observe, the interrelationships between the levels.

Functional Job Analysis

This method is also not well suited for identifying fundamental skills requirements at the specialty and career field levels. It is a labor intensive process that has a primary emphasis on job outputs, or, what gets done. Its advantage is that it presents a coherent picture of the job; the data, people or things that are worked with, and the level of complexity involved with these dimensions.

Its largest disadvantages for AF use is design, use and time/cost as the analysis can only be conducted by trained analyst using job documentation and SME interviews. This method would need considerable supplemental information to address specialty and career field applications, including a more specific delineation of job requirements. Also, a supplemental questionnaire should probably be used with this approach to assure that a representative cross-section of employees have had input. Consequently, it is not of direct applicability for AF needs.

The Position Analysis Questionnaires (PAQ)

This method has several characteristics that are aligned with the objective of identifying skills at the career field level. It is a worker-oriented instrument that can be administered to broad ranges of jobs; as such, however, it may not be well suited for application at the specialty level. Although the PAQ does relate to the universe of work, there may be concern that it is somewhat too broad and general for application even at the career field level. Also, several of the questions on the instrument do not relate to trainable skills and they may yield extraneous information.

Disadvantages for career field PAQ application are that the dimensions are a bit too broad and the scaling for assessing the amount of the requirement for any job element is vague and ill defined. The PAQ authors recommend that an analyst be trained in the PAQ, and that the trained analyst spend two and a half hours interviewing a job holder to accurately complete the questionnaire. Obviously, for an organization the size of the Air Force, this would require a very considerable commitment of resources.

The PAQ provides a very global perspective of jobs at the level of worker elements. In providing continuity to the specialty and task level, it must be supplemented or linked to other methods of job analysis. More detailed skills elements could be added to the questionnaire, and the PAQ items that are not central to fundamental skills identification could be deleted.

Ability Requirements Approach

Although designed to identify ability, not skill, requirements, this approach appears to have two key characteristics that would be of use in identifying fundamental skills at the career field level. First, it uses a worker-oriented approach, identifying skill and ability requirements of jobs. Second, it uses behaviorally anchored rating scales to define the level and amount of a particular skill or ability that is required in a particular job.

Not all the ability scales will be relevant to the career field level of analysis. The 15 cognitive and perhaps some of the perceptual and information process skills may be relevant, where the 30 psychomotor, physical, and sensor scales are likely to be less relevant. These scales, because of their behaviorally anchored format, may provide an effective measure of relating task, specialty and career field levels of

analysis. By this, we mean that it may be possible to combine tasks into broader specialty-specific fundamental skills and then combine them into career field skills. This is facilitated by the preciseness of the definitions and the clarity of the anchors.

The Ability Requirements Scales should be supplemented to effectively assess career field and specialty fundamental skills requirements. More specific dimensions should be constructed to cover a more comprehensive and specific domain of work. For example, elements from the PAQ, Threshold Traits Analysis and, possibly, Functional Job Analysis could be reviewed and adapted as appropriate to complement the relevant Ability Requirements Scales. Also, observation and interview techniques could be used in a similar fashion.

Generic Skills Approach

This approach identifies trainable skills that cut across a range of entry level vocational jobs. It is particularly relevant to this evaluation since the approach has been used in Canada to identify skill requirements common to a variety of jobs. The taxonomy of common job-related skills encompasses the following areas:

1. Mathematics. Includes 60 objectives for 11 skills dealing with whole numbers, fractions, decimals, percents, mixed operations, measurement/calculation, algebra, metric scales/conversion, geometric figures, and graphs.

2. Drawings. Includes six objectives dealing with reading, measurement, and production of assembly, schematic, or shop drawings.

3. Verbal skill. Includes 40 objectives for 12 reading, listening, writing, and speaking skills dealing with various topics and materials.

4. Information organization. Includes four objectives dealing with sorting, ranking , and classifying data and objects.

5. Tools, equipment and materials. Includes four objectives dealing with selection or analysis to tools, equipment, and materials.

These skills are relevant to both the career field and specialty levels if skill requirements in specialties are aggregated into the generic skills requirements at the career field level. This method may also provide linkages to tasks. Ratings on task linkages to the skills would have to be obtained, then computer analysis could identify the tasks skills that aggregate into specialty skills and, in-turn, aggregate into career field skills.

This approach represents one of the few methods we reviewed which has, as its sole purpose, the determination of generic skill requirements. However, the existing list of skills is not comprehensive of the domain of AF work as the analysis

appears to be oriented toward entry-level trade and labor jobs. For AF application, extensive on-site interviewing would be required for each unit of analysis with the required skill sets identified within each context in which the skills are used. Also, the approach would need to be modified to identify fundamental as well as generic technical skills required.

The Job Components Inventory (JCI)

The JCI is an extension of the Generic Skills and PAQ approaches and consequently has a more comprehensive listing of skills. However, the extensive listing of tasks and pieces of equipment may be too specific for career field and even specialty levels of analysis. Also, there may be an insufficient number of cognitive skills for AF application.

As with other methods we reviewed, a major disadvantage of the JCI is the cost and the time associated with its use. The usual procedure in completing the JCI is for a trained interviewer, after familiarization with the job and workplace, to read the JCI items to job incumbents and record their responses. This approach hardly seems feasible for any widespread AF use.

This inventory could be enhanced through observation and interview techniques to more uniformly assess the domain of AF skills at all levels. Also, instruments such as the Ability Requirements Scales could be reviewed for appropriateness of supplemental application.

Task Inventory/CODAP

This method is a job-oriented approach which is ideally suited for identifying task-specific skills. As such, its "microscopic" level of analysis may be too specific for the skills identification needs at the specialty and career field levels of analysis. As McCormick (1979) argues, the job-oriented approach should be translated into a worker-oriented approach to effectively address a range of jobs. A work task to worker characteristics linkage process needs to be implemented so CODAP tasks can be translated and aggregated into skills requirements.

Drauden (1988) describes such a linkage process. In essence, subject matter experts relate the degree to which a knowledge, skill or ability is required to perform a task. Then, by using a CODAP analysis where percent time requirements of jobs are defined, it is possible to specifically identify the knowledge, skill and ability requirements. By using different aggregates of data, it is possible to identify aggregate task descriptions at the specialty and career field levels and then it is possible to identify fundamental skills requirements at the these levels.

Using Drauden's approach, the skills requirements that are identified by one of the worker-oriented approaches can be reconfirmed and cross-validated to tasks.

The General Work Inventory (GWI)

The GWI appears to be a job analysis tool that is well suited for identifying fundamental skills requirements at both the career field and specialty levels.

It incorporates both a work-oriented and a worker-oriented approach and addresses a wide range of cognitive, physical, and interpersonal skills. It has been used within AF populations and, consequently, is well suited for the breadth and type of skills required of AF jobs. As indicated, the GWI incorporates both work-and worker-oriented behavior. This helps establish the linkage between task, specialty and career field levels of analysis. Linkages to CODAP task data may be established and linkages may be made via an adaptation of Drauden's (1988) translation approach discussed above.

One concern about the GWI for AF application is that it might not be fully comprehensive in terms of the skills covered. It could possibly benefit from some supplemental items extracted from the Ability Requirements Scales, other instruments, or observation/interview techniques. Of particular benefit would be the inclusion of behavioral-anchored rating scales that may effectively assess the skills requirements of particular jobs. These could be similar to the scales used in the Ability Requirements Approach (i.e., "Skills Requirements Approach").

An Evaluation of Methods for Career Field and Specialty Level Applications

An integration of the above issues regarding the job analysis methods in the context of the nine evaluation criteria discussed earlier in this paper (Section IV) has been performed for career field application. Figure 5 presents an evaluation of the ability of each of the previously described job analysis methods to meet each of the criteria. If the method appears to clearly meet the criteria, a "yes" has been entered in the appropriate cell. If the method appears to clearly not meet the criteria, a "no" has been entered in the appropriate cell. Finally, if we were uncertain as to whether the criteria are being met, a "?" was entered in the cell. The rationale for the ratings is presented in the preceding analysis of each of the eight methods. An overall index of consequence with AF fundamental skills criteria was then calculated. This is simply the sum of points awarded for such method, calculated in the following manner: 10 points for a "yes," 5 points for a "?," and 0 points for a "no." In this way an overall ranking of methods was obtained, ranging from 40 points for Functional Job Analysis to 80 for the GWI.

An analysis of the methods for specialty level application provided essentially the same results, as advantages and disadvantages for the various methods appear to be consistent across both levels of analysis. In general, the GWI and the Generic Skills approach appear to have most relevance at both levels. For specialty application, the GWI appears to have the greatest number of elements that are relevant to fundamental skills.

Perhaps even more so than for career field application, a job analysis approach must be customized for specialty application. To be comprehensive of the specialty skills, it is all the more important to consider enhancing the GWI with supplemental skills elements and behaviorally anchored rating scales.

METHOD	1. TRAINABLE	2. MEASURABLE	3. APPROPRIATE LEVEL	4. COMPREHENSIVE	5. VALID	LINKAGE 6.	DESIGN 7.	USE 8.	TIME/COST 9.	TOTAL
1. *Observation/Interview*	Yes	?	Yes	Yes	?	Yes	Yes	No	No	60
2. *Functional Job Analysis*	Yes	?	No	?	Yes	Yes	No	No	No	40
3. *Position Analysis Quest*	No	Yes	No	No	Yes	No	Yes	?	Yes	45
4. *Ability Requirements*	Yes	Yes	No	No	Yes	?	?	Yes	Yes	60
5. *Generic Skills*	Yes	Yes	?	No	Yes	Yes	No	?	Yes	60
6. *Job Components Inventory*	Yes	Yes	?	No	Yes	Yes	Yes	No	No	55
7. *Task Inventory/CODAP*	?	Yes	?	?	Yes	?	No	Yes	Yes	60
8. *General Work Inventory*	Yes	Yes	?	?	Yes	Yes	Yes	Yes	Yes	80

Note: A "?" counts 1/2 in calculating percentages

Figure 5. An Evaluation of Job Analysis Methods For Career Field Application

Relationship Between Methods at the Different Levels of Analysis

As discussed earlier in this paper, the worker-oriented, questionnaire-based approach may be best suited for addressing fundamental skills requirements at the career field and specialty levels. A method such as the GWI, supplemented with additional items, may be best suited for AF application. The nature of the supplemental items may vary depending on whether the application is at the career field or the specialty level. As an example, a set of relatively broad set of skill items may be added for use at the career field level, supplemented by even more specific items at the specialty level. Since worker-oriented, skills-based elements are recommended for use at both levels, there is a direct relationship and direct path of linkage between the two levels. The career field skills are aggregated from the specialty level, and are generally broader in nature.

The linkage to the CODAP task data base is not as direct. As indicated previously, a linkage process must be implemented to translate task skills into the

fundamental skills of a worker-oriented approach. The translation matrix of Drauden (1988) serves as an effective prototype of how this might be accomplished.

No other method appears to bridge the career field and specialty level of analysis as effectively as the GWI. The Job Components Inventory and the Generic Skills approaches have potential but are targeted toward entry-level vocational jobs rather than the very diverse range of jobs in the Air Force. An empirical approach for deriving common GWI estimates within the various classification levels is presented in the next section.

Summary

Results of our evaluation indicate that the GWI would be the best tool to use in an AF wide (career field or specialty level) analysis. However, this recommendation must be tempered by our previous comments that no one method is totally appropriate, and that a combination or integration of elements from different tools and approaches may be the best solution.

In reviewing our evaluation results, it appears that the criteria which discriminated most heavily between the methods, and consequently favored the GWI, were "design", "use", and "time/cost." Since the GWI is a survey based approach which has been used for several large efforts in the Air Force context, it's not surprising that it would score high on the implementation criteria. Further, it has a number of elements which measure skills, and may need little modification to assess the full range of appropriate skills in a cost efficient manner. However, the GWI will probably need to be refined and supplemented with additional items. These items can be identified through an observation/interview process, or adopted from other worker - oriented instruments.

Before addressing these issues, it is worthwhile to more closely examine the method. Therefore, the next section contains a discussion of the GWI, and a conceptual model of how it might be applied at the various classification levels.

VI. THE GENERAL WORK INVENTORY (GWI): A NOMOTHETIC APPROACH TO DETERMINING FUNDAMENTAL SKILL REQUIREMENTS

To date, most job analytic approaches have generated descriptions applicable to single jobs or limited job categories. Examples include the U.S. Employment Service's narrative job schedules (U.S. Department of Labor, 1972), Flanagan's (1954; Bownas & Bernardin, 1988) critical incident technique, and the more recent job-task inventory method (Christal & Weissmuller, 1988). Although these methods provide very useful and detailed information about individual jobs, they are limited in their capacities for comparing similarities and differences across broad job

ranges. These methods might be characterized as "ideographic" in their approach to job description (Cunningham, 1990).

Another, more "nomothetic," approach to job analysis uses descriptors applicable to broad ranges of jobs (Cunningham, 1990; Ballentine, Cunningham, & Wimpee, in press). This approach, pioneered by E. J. McCormick at Purdue University, is exemplified in the Position Analysis Questionnaire (PAQ). The PAQ follows the "job component" approach (McCormick, 1979), involving the strategy of (a) defining a universal set of job descriptors, or "components," applicable to the entire job population and then (b) establishing the human aptitude requirements estimates that can be derived for any job that has been profiled on the components. Although the nomothetic approach has the advantage of general applicability across the job spectrum, it does not offer the focused, detailed task information provided by the more ideographic methods.

Following McCormick's approach, Cunningham and Ballentine (1982) have developed a 268-item nomothetic job-analysis questionnaire within the Air Force context. This questionnaire, the General Work Inventory (GWI), is based partly on earlier research with a considerably longer (617-item) taxonomic instrument, the Occupation Analysis Inventory (OAI), (Cunningham, Boese, Neeb, & Pass, 1983). The GWI is organized into eight major sections of items (or work elements) as shown in Table 5. It differs from the PAQ in containing both worker-oriented and job-oriented elements, thus allowing it to describe and compare jobs in terms of (a) basic human activities and requirements and (b) technological content relevant to the purposes and outcomes of work. Unlike the typical narrowly defined job-oriented elements (e.g., task statements), however, those in the GWI are designed for application to a variety of jobs. Figure 6 shows the two GWI rating scales. The work elements dealing with information and activities (sections A through F of the GWI) were rated on the part-of-the-job scale. Those elements dealing with work conditions and benefits/opportunities (sections G and H of the GWI) were rated on the extent-of-occurrence scale.

In previous research, GWI position ratings were carried out by over 2,100 incumbents in 180 Air Force enlisted jobs, subsumed under 164 specialties. Based on those ratings, factor analyses of seven different sections of GWI elements (sections B through H in Table 5) produced 58 interpretable "work dimensions." The 48 factors from GWI sections B through F were used subsequently as profile variables in a cluster analysis of the 180 jobs. The resultant solution contained 21 meaningful and stable job clusters that merged into broader job families.

With further refinement, GWI-derived job clusters or families might provide useful categories within which common fundamental skills requirements could be determined, with the clusters' GWI element- or factor-score profiles providing some guidance as to the nature of those requirements. (Alternatively, GWI commonalities could be explored within the existing Air Force Career Fields.) Moreover, the GWI variables (elements and/or factors) could be linked to indepen-

dently defined fundamental skills/knowledge according to McCormick's (1979) job-component procedure, thus enabling the GWI to profile jobs for their estimated skill requirements as well as their salient activities and conditions (i.e., as represented by their element and factor-score profiles). Commonalities in jobs' GWI skill-requirement estimates could then be established within job clusters, career fields, or, perhaps in some cases, across the entire spectrum of enlisted specialties; or skill-requirement estimates could simply be derived and used for entry-level jobs in each separate specialty.

Table 5. Numbers of Job Rating Elements in the GWI Sections

Section Codes and Titles	Number of Elements
Section A: Sensory Activities	9
Section B: Information Elements	
B - 1. Forms of Information Received/Used	8
B - 2. Information-Related Activities	19
B - 3. Content of Information Received/Used	44
Section C: General Mental Requirements	15
Section D: General Physical Requirements	12
Section E: Physical Activities	
E - 1. Tools/Equipment/Machines Used or Operated	25
E - 2. Work Performed with Tools/Equipment/Machines/Devices	40
E - 3. Other Physical Work Activities	8
E - 4. Objects/Materials Acted Upon	15
Section F: Interpersonal Activities	22
Section G: Work Conditions	23
Section H: Job Benefits/Opportunities	28
Total	268

Part of the Job	Extent of Occurrence
1. An extremely small part of the job	1. An extremely small extent
2. A very small part of the job	2. A very small extent
3. A small part of the job	3. A small extent
4. A fairly small part of the job	4. A fairly small extent
5. A moderate part of the job	5. A moderate extent
6. A fairly large part of the job	6. A fairly large extent
7. A large part of the job	7. A large extent
8. A very large part of the job	8. A very large extent
9. An extremely large part of the job	9. An extremely large extent

Figure 6. The GWI Rating Scale

As mentioned, the job-component approach involves weighting a set of generally applicable components (various kinds of work activities and conditions) on their requirements for specified human attributes (in this case, fundamental skills/knowledge). This approach is depicted in Figure 7, which shows requirement weights for GWI job components (e.g., work elements or factors) on k defined fundamental skills. Examples of fundamental skills, such as identified by the SCANS Commission (Swoboda, 1991), might include: reading, writing, speaking, mathematical skills, sociability, negotiating, serving clients/customers, and various equipment maintenance and troubleshooting skills.

	Fundamental Skills			
Job Components	1	2	3	k
1	w11	w12	w13	w1k
2	w21	w22	w23	w2k
3	w31	w32	w33	w3k
•				
•				
9	wq1			wqk

Figure 7. Component Weights by Fundamental Skills Requirements

In Figure 7, a job's estimated requirement for skill 1 could be derived by taking the sum of cross products of the job's scores on the q GWI components times the components' requirement weights for that skill. The weights might have values that vary along some scale, or could simply have values of zero or one. They could be derived in two different ways: (a) through experts' ratings of the GWI components' requirements for defined fundamental skills, or (b) through a "policy-capturing" procedure involving multiple regression analyses in which jobs' component scores serve as predictor (x) variables and some measure of the jobs' requirements for a specified skill serves as the criterion (y) variable (i.e., in this case, the components' skill-requirement weights would be regression coefficients). The criterion variable under the latter approach might be based, for example, on experts' direct ratings of jobs' skill requirements, on the mean skill-test scores of representative samples of successful job incumbents, or on jobs' empirically established test-score cutoffs. The job-component scores could be based on GWI ratings carried out by position incumbents, supervisors, or experts. To date, multiple regression analyses have been carried out using the GWI factor scores for 130 Air Force enlisted jobs as x variables and the jobs' mean ASVAB subtest scores and VOICE interest scale scores (for large incumbent samples) as y variables; substantial multiple correlations were obtained. Research to be initiated this year will use both approaches a and b above in establishing the requirements of GWI elements and factors for various human abilities as defined by Fleishman's Ability Requirements Scales (Fleishman & Quaintance, 1984). Success in linking the GWI variables to established cognitive and psychomotor abilities, physical capacities, and work-related interests would augur well for the instrument's usefulness in establishing jobs' fundamental skill requirements.

Thus, under the job-component approach, predefined fundamental skills would be linked to GWI components representing concrete classes of work activities and conditions, and jobs' requirements for those skills would be determined from their GWI component scores in combination with the components' skill weights. (In addition, many of the GWI component descriptions themselves are suggestive of skill requirements.) This approach would not only provide estimates of a job's (or job family's) fundamental skill requirements, but also an explanation of why they were required (i.e., because the job consists of specified kinds of activities and conditions that require those skills). Moreover, the GWI's twelfth-grade reading level makes it usable by any literate respondent who is knowledgeable of the job to be analyzed (Cunningham, 1990). Accordingly, it is feasible to obtain GWI position ratings from incumbents or job ratings from supervisors and experts.

VII. CONCLUSIONS AND RECOMMENDATIONS

This section summarizes key conclusions and implications based on our review of fundamental skills needs assessment methods. Conclusions are presented within three topical areas, reflecting the project's primary research objectives: (a) investigate alternative theoretical orientations for defining fundamental skills, (b) evaluate

methods for determining requirements for fundamental skills at varying levels within the Air Force (i.e., career fields, specialty level, and possibly job/task level), and (c) address the interrelationship among analytic systems supporting these requirements. We conclude the paper with recommended next research steps for AF consideration.

Theoretical Orientations for Defining Fundamental Skills Definition

We have proposed a framework and guidelines for defining fundamental skills which can be used to assist in the review of the various conceptual orientations. We further proposed six specific criteria to be used in defining fundamental skills for AF training purposes. In essence, these criteria require that for a skill to be identified as fundamental, it must be linked to job required activities, must be capable of being reliably measured (both within the person and as required by the job), and must be trainable.

Context

Using our proposed guidelines and criteria, skills which are most likely to be considered as fundamental would be those which are relatively free of explicit occupational content. These skills would range from basic educational and social skills which would be required to varying degrees in all AF jobs, to skills which are more technological in nature and relate more specifically to the various occupational areas. Using the JSEP as an example (Appendix B), vocabulary and algebra would be the more generic ("core") skills, where reading flow charts and understanding schematics would be more occupation specific (i.e., maintenance) generic skills.

In reviewing previous fundamental skill training efforts and the various relevant concepts (summarized at the end of Section III), one is struck by the overriding influence of the work context. Indeed, the effect of this context appears so strong, there is significant risk in assuming that fundamental skills can be defined at levels above the job (e.g., career field, specialty level). This is not to suggest that an absolutely unique set of fundamental skills must be defined for each job. There are apparent overlaps among many jobs in what they demand from job incumbents (i.e., "families" of jobs). However, each job demands some things to some level, and knowing what those things are appears critical, ultimately, to understanding what should be trained and who should be trained.

Fundamental skills training programs have tended to focus on literacy skills, and have varied significantly in the degree to which they relate to the work context. Those programs which appear to be the most successful, such as JOBS and JORP, have aligned their training objectives closely with specific aspects of the work or follow-on training context. As noted in the literature and by our workshop panel, "generic" fundamental skills training programs have been less successful in demonstrating evidence of learning transfer to the work context. This difference

between the methods is most often attributed to the enhanced meaningfulness of the functional context approach.

However, "meaningfulness" for the individual is socially based and the product of ongoing interactive processes within the individual's particular social/cultural context. A consensus among all of the theoretical orientations we reviewed for this paper is that a learning task is far more meaningful if it is framed in a manner which is consistent with the individual's particular knowledge and experience base. As an example, at our workshop Steven Ceci discussed his research with experienced racetrack betters where they did very poorly on a stock market simulation. When he gave them hints about how the market simulation was related (contextually) to horse racing, their performance improved dramatically. (A summary of workshop notes is presented in Appendix E). The challenge for training developers is to identify those knowledges and experiences within the training population which lead to enhancements in the learning process when connected to new tasks or problems.

Diversity

The U.S. workforce is becoming more diverse as proportionality more women, minorities, and immigrants enter the work market. Those organizations that can adapt to culturally diverse workers will have the opportunity to attract and retain the most qualified people in these groups and motivate them to perform successfully. To that end, the Air Force should consider collecting and disseminating information pertaining to diversity-related issues, and conducting diversity training.

An individual's knowledge structure and "view of the world" is socially and culturally based, implying a requirement for trainers to know more about the trainees shared cultural determinants of behavior. As the demographics of the recruit population changes over the next few years, changes in the way the Air Force trains may have to occur to maximize the learning process and subsequent success of new workforce entrants. The mission of the Air Force will not change; the issue is, how best to help those from various social groups learn the necessary fundamental skills which underlie the successful accomplishment of that mission.

Methods for Determining Fundamental Skill Requirements

Methods Evaluation

The identification of fundamental skill requirements must be based on an understanding of the nature and requirements of the Air Force work context. This understanding is provided by a methodology and a process known as job analysis. However, there is no "best method"of job analysis for every application as there are several parameters which must be considered when selecting the best process for any given purpose. Perhaps the most significant parameter we discussed, in terms

of influencing our evaluation of the various methods, is the method of data collection. Small organizations with just a few jobs to analyze might find it economical to employ the more unstructured techniques such as observation. In contrast, organizations as large as the Air Force with many jobs within a variety of specialties and career fields usually find structured questionnaires to be the most efficient and effective data collection method. Thus, we recommend this technique for fundamental skills analysis. We further recommend that the particular method selected be worker-oriented in order to describe the job in terms of the worker fundamental skills required.

We evaluated a number of job analysis methods and approaches for their suitability in defining AF wide requirements using nine criteria. The first six criteria pertained to the quality and utility of the outputs, or results, of the job analysis methodologies. The last three criteria pertained to the feasibility of the process for implementing the method. The latter three proved to be the most discriminating of the criteria, as some methods were clearly more readily adaptable for use in identifying skill requirements than others, resulting in less cost in time and resources for modifying the method for AF use. Our analysis revealed that a recently developed method, the General Work Inventory (GWI), is well suited for AF application at both the career field and specialty level. However, the optimal technique for identifying AF fundamental skill requirements may include a combination of elements from the GWI and other worker-oriented instruments.

In addition to being a worker, as well as work-oriented questionnaire, the GWI has several other features that favorably influenced the evaluation decision: (1) it has a number of existing elements which are likely to measure fundamental skill requirements depending, of course, on how the skills are defined; (2) there is existing evidence for its reliability and validity for use within the Air Force context; (3) in consideration of the time and resources required to modify/use the other methods reviewed, it is probably the least costly alternative which can be expected to be effective; and (4) it can be linked to other AF personnel data bases to enhance the person-job matching process. Regarding point number four, a project is currently ongoing to link the GWI factors to ASVAB abilities, the Air Forces Vocational Interests for Career Enhancement (VOICE), and existing task learning difficulty ratings for enlisted specialties. A fundamental skills analysis would add a worthwhile dimension to that research effort.

Alternative Approaches

Our evaluation conclusions regarding the GWI are based upon selecting a method which can be used to identify AF wide fundamental skill requirements on the job. This is in line with our assumptions concerning the need to evaluate the various methods for Air Force use. However, if the Air Force has as its objective the identification of prerequisite skills necessary for success in training (only), or is concerned about skill requirements in only a few specialty or career areas, then other approaches that we have reviewed in this paper might be preferable. As an

example, the specific skills taught in the Navy JOBS program were identified by determining generic concept knowledge requirements for success in particular technical training programs. This method, supplemented by expert interviews and reviews of the training documentation, might suffice for the Air Force if success in particular technical training courses is the ultimate objective.

A concern we have with the JOBS approach is that methodologies designed solely to identify prerequisites skills for learning higher-order or more technical skills will naturally focus on cognitive requirements. Rarely (if at all) are interpersonal and other social skills listed as technical training learning objectives or prerequisites. While cognitive skills are certainly important to success on the job, other skills may be fundamental to success as well. As an example, the SCANS effort we discussed has identified five categories of competencies (presented previously in Table 4) which meet our definition of fundamental skills, and encompass a range of skills which would not be traditionally considered as cognitive (e.g., "interpersonal skills," "managing resources"). These skills, according to the SCANS, differ from a person's technical knowledge but are at least as important in all occupational areas. They might also be just as important for success in a variety of AF work contexts. As an example, in addition to task specific technical knowledge regarding how to repair an item, a successful maintenance technician might need to know how and why to budget resources, teach others new skills, work well with divergent others, understand how the AF organizational system works, and so on.

Conceptually, the SCANS taxonomy of "foundation skills" and "competencies" is similar to our taxonomy of "core" and more "occupation specific" fundamental skills discussed in section II. We would encourage the Air Force to pursue a needs analysis approach which examines the requirement for a representative set of skills which are related to successful job performance. As with our maintenance example, the SCANS taxonomy might serve as an initial set of skills to examine the requirement for an expanded set within various AF occupational areas.

Relationships Among the Methods at Different Levels of Analysis

Ideally, a common methodology is preferrable for the different levels of analysis (e.g., career field, specialty, or task level) in order to identify common skill factors within the occupational areas. Further, data collected by this common method provides the capability for aggregation to more molar levels of analysis, such as job to job families, without losing a direct link to the job tasks. A method we have recommended which can achieve this, with modifications, is the GWI.

Through averaging, the GWI position ratings from incumbents/superiors can be aggregated into jobs, specialties, and career fields (or numerically derived job groupings); or direct job or specialty ratings by analysts can be aggregated into broader categories. Such aggregation would provide information on skill requirements at different levels, ranging from single jobs to broad job families. For

example, common skill requirements could be determined among jobs or specialties within career fields and/or career-field subdivisions (e.g., clusters). Once the system of skill-requirement weights was established for the GWI components (see Figure 7), skill requirements could later be determined for any job or job grouping based on GWI ratings by incumbents or supervisors, rather than by scarce and expensive experts using involved and time-consuming procedures. GWI analysis also could be applied to new, proposed, or consolidated jobs.

Finally, the GWI is seen as complementary and linkable to existing job-task inventory information. It should prove feasible, for example, to use the GWI to rate and cluster tasks, duties, or task modules across a range of enlisted jobs. Task modules are task groupings within specialties based on position rating covariance (Perrin, Knight, Mitchell, Vaughan, & Yadrick, 1988). The resultant clusters, in turn, could serve as job descriptors (in addition to the GWI variables), with scores derived from jobs' existing position ratings on the clusters' constituent tasks. These clusters would contain more specific information than the GWI, while applying to broader job ranges than individual task or duty statements. An established GWI-task relationship of this kind would support the development of a vertically integrated occupational information system, ranging from tasks to the existing career fields (or to numerically derived job groupings). Moreover, each task cluster would have a mean GWI component score profile and hence a derivative profile of fundamental skill requirement estimates. These GWI-derived task clusters might provide a basis for developing general occupational training programs for which prerequisite fundamental skills would be specified.

Recommendations for Proceeding

Following our conclusions, we see several approaches which could work well for the Air Force in continuing the fundamental skills needs analysis research. The preferred approach for AF-wide application would be a structured questionnaire method such as the GWI. Perhaps the greatest value in this approach is the capability to collect data which pertains to decisions which could enhance the selection and classification of AF personnel as well as fundamental skills training. Further, with the components analysis process we have described, the GWI provides a method to estimate requirements for jobs that may not yet exist. This may become a critically important capability as future system and technology changes redefine the nature of jobs at the same time that characteristics of the workforce are becoming more diverse.

However, use of the GWI for this purpose must be preceeded by data collection efforts to determine what skills would be considered as fundamental for success in a representative sample of occupational areas. This data could be collected from SMEs using structured questionnaires and focus group sessions. The questionnaires could be designed to have the respondents rate the importance of underlying skills and competencies, such as those listed by the SCANS, to effective job performance in their particular occupational area. The focus groups would provide additional input

concerning potentially important fundamental skills which have not been identified by our review, or included in the SCANS list.

The next step in the analysis would be to revise the GWI, as required, to measure the skills endorsed or listed by the experts. (This step could be initiated concurrently with step one by using the potential elements rated by the SMEs). Follow-on steps would include pilot testing of the GWI, and administering it to an appropriate sample of personnel and specialties. Results of the sample analysis would identify fundamental skill requirements within the various specialty or job family clusters.

Another approach, which is more constrained in it's objective, is to identify skill requirements for success in training only. If this approach is taken, an analysis of training documentation and interviews with SMEs could be undertaken to determine the underlying skills which facilitate the learning of more technical skills being taught in the training courses. We discussed a feasible model for this approach earlier in this section, using JOBS as a potential prototype. We also discussed our concerns with the approach being focused on the identification of cognitive skill requirements for a limited number of occupational areas.

Although the GWI provides a capability for measuring relative fundamental skill requirements within and among occupational clusters, there is still a need to identify skill levels required within individuals. While this research presupposes a clearly defined set of fundamental skills, it eventually must be done to identify training requirements and potential enhancements to the Air Force personnel selection and classification process.

One method for developing these metrics which should be given serious consideration is to use a Behaviorally Anchored Rating Scale (BARS) approach similar to the approach used by Fleishman and his colleagues in developing the Ability Requirements Scales (Fleishman & Mumford, 1988). The use of a BARS technique provides a reasonably straightforward method for rating the degree of skill required in the job, or the necessary competency level required for effective performance. As an example, the fundamental skill of reading might range from a 2 on the BARS ("must comprehend simple sentences") to 7 ("must comprehend legal contracts").

The development of these scales, and the batteries of diagnostic tests used to determine the degree of individual skill possession, could be a substantial undertaking. For example, one problem is simply keeping a battery of fundamental skills tests to a reasonable length. Attempting to assess performance on even a few fundamental skills, say 50, would require a battery of tests involving hundreds of items. Given the implications of context effects, parallel items may be needed for application in different occupational areas.

The problems are far from insurmountable. For illustration, computer adaptive testing might be employed to reduce the number of test items any particular

individual would have to consider during testing. Also, techniques/methods which exist now, such as the Air Force Reading Abilities Test (AFRAT), the Army's JSEP diagnostics, and the ASVAB, may suffice as at least surrogate measures for some of the skills.

REFERENCES

Anderson, J. R. (1987). Skill acquisition: Compilation of weak-method problem-solutions. Psychological Review, 94, 192-210.

Ballentine, R. D., Cunningham, J. W., & Wimpee, W. E. (In Press). Air Force enlisted job clusters: An exploration in numerical job classification. Military Psychology.

Bandura, A. (1977). Social Learning Theory. Englewood Cliffs, N.J.: Prentice-Hall.

Berger, P. L. (1963). An invitation to sociology. New York: Doubleday.

Berger, P. L., & Luckmann, T. (1967). The social construction of reality. New York: Doubleday.

Bernardon, N. L. (1989). Let's erase illiteracy from the workplace. Personnel, 66, 29-32.

Bloom, B.S. (1956). (Ed.) Taxonomy of educational objectives. Handbook I: Cognitive Domain New York: Makay.

Bloom, B.S., Hastings, J.T., & Madaus, G.F. (1971). Handbook on formative and summative evaluation of student learning. New York: McGraw-Hill.

Blumer, H. (1969). Symbolic interactionism. Englewood Cliffs, NJ: Prentice-Hall.

Bownas, D. A. & Bernardin, H. J. (1988). Critical incident technique. In The Job Analysis Handbook for Business, Industry, and Government. Gael (Ed.). New York: Wiley.

Bransford, J. D., Arbitman-Smith, R., Stein, B. S., & Vye, N. J. (1985). Improving thinking and learning skills: An analysis of three approaches. In J. W. Segal, S. F. Chipman, & R. Glaser, (Eds.), Thinking and learning skills: Vol 1. Relating instruction to research. Hillsdale, NJ: Erlbaum.

Brown, A. L., Bransford, J. D., Ferrara, R. A., & Campione, J. C. (1983). Learning, remembering, and understanding. In J. H. Flavell and E. M. Markman (Eds.), Cognitive development (Vol. III of P. H. Mussen, Ed., Handbook of child psychology). New York: Wiley.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18, 32-42.

Carnevale, A. P., Gainer, L. J., & Meltzer, A. S. (1989, March). Best practices: What works in training and development -- Basic skills. Alexandria, VA: American Society for Training and Development.

Chance, P. (1987, April). Master of mastery. Psychology Today, 43-46.

Christal, R. E., & Weismuller, J. J. (1988). Job-task inventory analysis. In The Job Analysis Handbook for Business, Industry, and Government. Gael, S. (Ed.). New York: Wiley.

Chomsky, N. (1968). Language and mind. New York: Harcourt Brace Jovanovich.

Collino, G. E., Aderman, E. M., & Askov, E. N. (1988). Literacy and job performance: A perspective. College Park, PA: Institute for the Study of Adult Literacy, College of Education, The Pennsylvania State University.

Cooley, C.H. (1922). Human Nature and Social Orders. New York: Schockem.

Cooney, J. (1978). Linking math, reading, and writing skills to jobs. San Mateo County, CA: San Mateo County Office of Education.

Cunningham, J.W. (1990). Introductory comments. In J. W. Cunningham (Chair), Quantitative job description and classification: Nomothetic approaches and applications. Symposium conducted at the 98th Annual Convention of the American Psychological Association, Boston.

Cunningham, J. W. & Ballentine, R. D. (1982). The General Work Inventory. Releigh, NC: Authors.

Cunningham, J. W., Boese, R. R., Neeb, R. W., & Pass, J. J. (1983). Systematically derived work dimensions: Factor analyses of the Occupation Analysis Inventory. Journal of Applied Psychology, 68, 232-252.

Cunningham, J. W., Wimpee, W. E., & Ballentine, R. D., (1990). Some general dimensions of work among U.S. Air Force enlisted occupations. Military Psychology, 21, 33-45.

D'Andrade, R. G. (1984). Cultural meaning systems. In R. A. Shweder, & R. A. LeVine, Culture theory: Essays on mind, self, and emotion. Cambridge: Cambridge University Press.

Department of Defense (1990) Population representation in the military services. Washington, D.C.: Office of the Assistant Secretary of Defense.

Drauden, G. M. (1988). Task inventory analysis in industry and the public sector. In M.D. Dunnette (Ed.), Handbook of Industrial and Organizational Psychology. Chicago: Rand-McNally.

Duffy, T. M. (1985). Literacy instruction in the military. Armed Forces & Society (Vol. II), Inter-University Seminar on Armed Forces and Society.

Ericson, K. A., & Chase, W. G. (1982). Exceptional memory. American Scientist, 70, 607-615.

Faneuff, R. S. (1990). 1988 reading grade level (RGL) data for Air Force specialties. (Technical Report No. AFHRL-TP-90-16). Brooks AFB, TX: Manpower and Personnel Division.

Farr, B. J., & Ward, J. S. (1988). The job skills education program: Technology transfer. Proceedings of the Conference on Technology, Training, and Education, Biloxi, MS, March 7-11.

Fingeret, A. (1983). Social network: A new perspective of independence and illiterate adults. Adult Education Quarterly, 33, 133-46.

Flanagan, J. C. (1954). The critical incident technique. Psychological Bulletin, 51, 327 -358.

Fleishman, E. A., & Mumford, M. D. (1988). Ability Requirements Scales. In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol II, (pp917-935). New York: Wiley

Fleishman, E. A., & Quaintance, M. K. (1984). Taxonomies of human performance: The description of human tasks. Orlando, FL: Academic Press.

Gael, S. (1988) (Ed.) The job analysis handbook for business, industry, and government (Vols. 1&2). New York: Wiley.

Gagne, R. M. (1962). The acquisition of knowledge. Psychological Review, 69, 355-365.

Gagne, R. M. (1965). The conditions of learning. New York: Holt, Rinehart, & Winston.

Gagne, R. M. (1968). Learning hierarchies. Educational Psychologist, 6, 3-6.

Glaser, R. (1984). Education and thinking: The role of knowledge. American Psychologist, 39, 93-104.

Gott, Sharrie P. (1986). "Basic Skills that Enable Competence in Complex Domains." In T.Sticht, F. Chang, and S. Wood (eds.). Cognitive Sciences and Human Resources Management: Advances in Reading/Language, Research Vol. 4. Greenwich, CT: JAI Press.

Gould, B., Archer, W. B., Filer, J., Short, L. O., & Kavanagh, M. J. (1988, April). Development of a methodology to estimate common task overlap. Paper presented at the Forth Annual Conference of the Society for Industrial and Organizational Psychology, Boston, MA.

Heath, S. B. (1983). Ways with words: Language, life and work in communities and classrooms. Cambridge, England: Cambridge University Press.

Heath, S. B. (1991). Belief in doubt: Testing the text in community based organizations for youth. A presentation of the Indiana University Literacy Forum, Bloomington, IN, March 27, 1991.

Hendrik, H. W. (1986). Macroergonomics: A conceptual model for integrating human factors with organizational design. In O. Brown and H. W. Hendrick (Eds.), Human Factors in Organizational Design and management II. Amsterdam: Elsevier.

Hirschorn, L. (1984). Beyond Mechanization: Work and Technology in a Post-Industrial Age. Cambridge, Mass.: MIT Press, 1984.

Horton, R. (1967). African traditional thought and Western Science, Part 2. Africa, 37, 159-187.

Huff, K. H., Sticht, T. G., Joyner, J. N., Groff, S. D., & Burkett, J. R., (1977). A Job Oriented reading program for the Air Force: Development and Field Validation. (AFHRL-TR-77-34). Lowry AFB, Colorado, Training Systems Division, Air Force Human Resources Laboratory.

Hyman, H., & Singer, E. (1968). Readings in reference group behavior. New York: Free Press.

Irvin, J.G., Blunt, J.H., & Lamb, T.A. (1988). A Training/JPA Model: Its utility for the MPT community. Dayton, Ohio: Universal Energy Systems.

Jakubovics, J. (1986). Coping with illiteracy in the workplace. Management olutions, 31, 5-11.

Jones, B. F., & Idol, L. (1990). Dimensions of thinking and cognitive instruction. Hillsdale, NJ: Erlbaum.

Kawula, W., & Smith, A. (1975). Generic skills. Training Research and Development Station, Department of Manpower and Immigration. Prince Albert, Saskatchewan, Canada.

Kelly, M. R. (1990). New process technology, job design and work organization: A contingency model. American Sociological Review. 55, 191-208.

Kent, W. (1973). A longitudinal evaluation of the adult basic education program. Falls Church, VA: Systems Development Corp.

Kincaid, J. P., Fishburne, R. P., Jr., Rogers, R. L., & Chisom, B. S. (1975). Derivation of new readability formulas for Navy enlisted personnel (NTTC-RBR 8-75). Millington, TN: Chief of Naval Technical Training, Naval Air Station.

Kincaid, J. P., & Fishburne, R. P., Jr (1977). Readability formulas for military training materials. Human Factors Society Bulletin, 19, 4-5.

Krathwohl, D.R., Bloom, B S., & Masia, B.B. (1964). Taxonomy of objectives. The classification of educational goals. Handbook II. Affective domain. New York: McKay.

LaBarre, W. (1945). Some observations on character structure in the orient: The Japanese. Psychiatry, 8, 326.

Lave, J. (1988). Cognition in Practice., New York: Cambridge University Press.

Lee, C. (1988). Basic training in the corporate schoolhouse. Training: The Magazine of Human Resources Development, 25, 27-34.

LeVine, R. A. (1984) Properties of Culture: An ethnographic view. In R. A. Shweder, & R. A. LeVine, Culture theory: Essays on mind, self, and emotion. Cambridge: Cambridge University Press.

Levi-Strauss, C. (1966). The savage mind. Chicago: University of Chicago Press.
Luria, A. (1976). Cognitive Development: Its Cultural and Social Foundations. Cambridge, MA: Harvard University Press.

Luria, A. (1976). Cognitive Development: Its Cultural and Social Foundations. Cambridge, MA: Harvard University Press.

Martinko, M.J. & Gardner, W.L. (1984). The Behavior of High Performing Educational Managers: An Observational Study. Department of Management, Florida State University.

McCormick, E. J. (1979). Job Analysis: Methods and Applications. New York: AMACOM.

McDaniel, D. M., Mathews, J. J., & Shalow, S. R. (1986). Readability grade level norms for "A" school training materials (Technical Report No. 86-015). Orlando, FL: Naval Training Systems Center.

McKendree, J., & Anderson, J. R. (1987). Effect of practice on knowledge and use of basic LISP. In J. M. Carrol (Ed.), Interfacing thought: Cognitive aspects of human-computer interaction. Cambridge, MA: Bradford Books/MIT Press.

Madden, H. L., & Tupes, E. C. (1966). Estimating reading ability level from the AQE General Aptitude Index (Technical Report No. PRL-TR-66-1). Lackland AFB, TX: Personnel Research Laboratory.

Mathews, J. J., & Roach, B. W. (1983). Reading abilities test: Development and norming for Air Force use (Technical Report No. AFHRL-TR-82-26). Brooks AFB, TX: Manpower and Personnel Division.

Mead, G.H. (1934). Mind, Self, and Society Chicago: University of Chicago Press.

Merton, R. K. (1957). Social theory and social structure. Glencoe, IL: Free Press.

Mikulecky, L. (1982). The relationship between school preparation and workplace actuality. Reading Research Quarterly. 17, 400-420.

Mikulecky, L. (1991). Personal communication describing a recent observation from a plant visitation.

Mikulecky, L. & Ehlinger, J. (1986). The influence of metacognitive aspects of literacy on job performance of electronics technicians. Journal of Reading Behavior, 18, 41-62.

Mikulecky, L. & Winchester, D. (1983). Job literacy and job performance among nurses of varying employment levels. Adult Education Quarterly, 34, 1-15.

Mitchell, J. L. & McCormick, E. J. (1979). Development of the PMPQ: A structural job analysis questionnaire for the study of professional and managerial positions. PMPQ Report No. 1. West Lafayette, IN: Purdue University, Department of Psychological Services.

Mockovak, W. P. (1974). Literacy skills and requirements in Air Force career ladders (Technical Report No. AFHRL-TR-74-90). Lowry AFB, CO: Technical Training Division.

Morris, N. M., & Rouse, W. B. (1985). Review and evaluation of empirical research in troubleshooting. Human Factors, 27, 503-530.

Mullis, I. V. S., Owen, E. H., & Phillips, G. W. (1990, September). America's challenge: Accelerating Academic Achievement. Washington, D.C.: Office of Educational Research and Improvement, U.S. Department of Education.

Neves, D. M., & Anderson, J. R. (1981). Knowledge compilation: Mechanisms for the automatization of cognitive skills. In J.R. Anderson (Ed.), Cognitive skills and their acquisition. Hillsdale, NJ: Erlbaum.

Northcutt, N., Seltz, N., Shelton, E., Nyer, L., Hickock, D., & Humble, M. (1975). Adult functional competency: A summary. Austin, TX: Division of Extension, University of Texas.

Page, R. C. & Van DeVoort, D. M. (1989). Job analysis and Human Resource Planning. In W. Cascio (Ed.), Human Resource Planning, Employment and Placement, Vol 2, of the ASPA/BNA Services on human resource management, Washington, D.C.: The Bureau of National Affairs.

Palincsar, A. S. (1989). Less charted waters. Educational Researcher, 18, 5-12.

Perkins, D. N., & Salomon, G. (1989). Are cognitive skills context-bound? Educational Researcher, 18, 16-25.

Perrin, B. M., Knight, J. R., Mitchell, J. L., Vaughan, D. S., & Yadrick, R. M. (1988). Training decisions system: Development of the task characteristics subsystem (Technical Report No. AFHRL-TR-88-15). Brooks AFB, TX: Training Systems Division. (NTIS No. AD A199 094).

Pestillo, P., & Yokich, S. (1988). A Michigan employability profile: Report to the Governor's commission on jobs and economic development. Lansing, MI: Employability Skills Task Force - Governor's Commission on Jobs and Economic Development.

Piaget, J. (1966). Need and significance of cross-cultural studies in genetic psychology. International Journal of Psychology, 1, 3-13.

Polson, P. G., & Jeffries, R. (1985). Instruction in general problem solving skills. In J. W. Segal, S. F. Chipman, & R. Glaser, (Eds.), Thinking and learning skills: Vol 1. Relating instruction to research. (pp. 417-455) Hillsdale, NJ: Erlbaum.

Postman, L. (1971). Transfer, interference, and forgetting. In J. W. Kling & L. A. Riggs (Eds), Woodworth and Schlosberg's experimental psychology. New York: Holt.

Pylyshyn, Z. (1978). When is attribution of beliefs justified? Behavioral and Brain Sciences, 1, 592-593.

Rayner, G.T., Darabi, A., & Farr, B.J. (1985). Job Skills Education Program: Review of the Job Task Analysis and Clustering Schema (Research Note 85-44) Alexandria, VAS. Army Research Institute.

Rayner, G.T., Wilson, L.S., & Farr, B.J. (1985). Job Skills Education Program: Design Specifications (Research Note 85-43). Alexandria, VA.: U.S. Army Research Institute.

RCA Service Company (1984). Needs assessment to define the training requirements for a Basic Skills Education Program (BSEP) Curriculum Development. (Army Contract No. DABT 60-81-C-0017). Cherry Hill, NJ: Author.

Ree, M. J., Mathews, J. J., Mullins, C. J., & Massey, R. H. (1981). Calibration of Armed Services Vocational Aptitude Battery Forms 8, 9, and 10 (Technical Report No. AFHRL-TR-81-49). Brooks AFB, TX: Manpower and Personnel Division.

Reigeluth, C., Merrill, M. D., Branson, R. K., Beglund, R., & Tarr, R. (1980). Extended Task Analysis Procedure (ETAP): User's Manual. Army Training Development Institute. Fort Monroe, Virginia.

Resnick, L. B. (1987a). Education and learning to think. Washington, DC: National Academy Press.

Resnick, L. B. (1987b). Learning in school and out. Educational Researcher, 16, 13-20.

Resnick, L. B. (1989). Introduction. In L. B. Resnick (Ed.), Knowing and learning: Essays in honor of Robert Glaser. Hillsdale, NJ: Erlbaum.

Rouse, W.B., & Johnson, W.B. (1990). Computational approaches for analyzing trade-offs between training and aiding. (AFHRL-TP-89-18). Brooks AFB, TX: Air Force Human Resources Laboratory.

Schendel, J. D., & Hagman, J. D. (in press). Long-term retention of motor skills In J. E. Morrison (Ed.), Training for performance: Principles of applied human learning. Sussix, England: Wiley.

Scribner, S. (1984). Studying working intelligence. In Rogoff, B. & Lave, J. (Eds), Everyday cognition: Its development in social context. Cambridge, MA; Harvard University Press.

Semerad, R. D. (1987). Workers in the year 2000: Why we're in trouble. American Teacher, 71, 7-12.

Shweder, R. A. (1984). Anthropology's romantic rebellion against the enlighten ment. In R. A. Shweder, & R. A. LeVine, Culture theory: Essays on mind, self, and emotion. Cambridge: Cambridge University Press.

Shweder, R. A., & Bourne, E. J. (1984). Does the concept of the person vary cross culturally? In R. A. Shweder, & R. A. LeVine, Culture theory: Essays on mind, self, and emotion. Cambridge: Cambridge University Press.

Simon, H. A., Hayes, J. R. (1976). The understanding process: Problem isomorphs. Cognitive Psychology, 8, 165-190.

Skinner, B. F. (1938). The behavior of organisms. New York: Appleton-Century Crofts.

Smillie, R. J. (1986). Design strategies for job performance aids. (Technical Report NPRDC TR 87-5). San Diego, CA: Navy Personnel Research and Development Center.

Smillie, R. J., & Clelland, J. C. (1986). Enlisted personnel individualized career system (EPICS): acceptance and use of job performance aids (JPAs). San Diego, CA: Navy Personnel Research and Development Center.

Spenner, K. (1989). Technological change, skill requirements and education: Thecase for uncertainty. In Cynert, R. & Mowery, D. (eds.) The impact of technological change on employment and economic growth. Cambridge, MA: Ballinger, 131-184.

Stasz, C., McArthur, D., Lewis, M., & Ramsey, K. (1990). Teaching and learning generic skills for the workplace (R-4004-NCRVE/UCB). Santa Monica, CA: The RAND Corporation.

Sticht, T. G. (1975). A program of Army functional job reading training" Development, implementation, and delivery systems. (Final report HumRRO-FR-WD(CA)-75-7). Alexandria, VA: Human Resources Research Organization.

Sticht, T. G. (1979). Developing literacy and learning strategies in organizational settings. In H. O'Neil, jr. and C. Spielberger (Eds.) Cognitive and affective learning strategies. New York: Academic Press.

Sticht, T. G. (1982). Basic skills in defense. (HumRRO PP-3-82). Alexandria, VA: Human Resources Research Organization.

Sticht, T. G., Armstrong, W. B., Hickey, D. T., & Caylor, J. S. (1987). Cast-off youth: Policy and training methods from the military experience. New York: Praeger.

Sticht, T. G., Fox, L., Hauke, R., & Zapf, D. (1977, September). Reading in the Navy (Tecnnical Report 77-40). San Diego, CA: Navy Personnel Research and Development Center.

Sticht, T. G., & McDonald, B. A. (1989). Making the nation smarter: The inter generational transfer of cognitive ability. San Diego, CA: Applied Behavioral & Cognitive Sciences, Inc.

Sticht, T. G., & Mikulecky, L. (1984). Job-related basic skills: Cases and conclusions. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University.

Swoboda, F. (1991). Job skills gap looms, panel finds. The Washington Post, May 30.

Tiffin, J., & McCormick, E. J. (1985). Industrial psychology. Englewood Cliffs, N.J.: Prentice-Hall.

Tolman, E. C. (1932). Purposive behavior in animals and men. New York: Century.

Thorndike, E. L. (1911). Animal intelligence. New York: The Macmillan Co.

Turner, J. H. (1988). A theory of social interaction. Stanford, CA: Stanford University Press.

U.S. Congress, Office of Technology Assessment. (1990, September). Worker training: Competing in the new international economy (OTA-ITE-457). Washington, DC: U.S. Government Printing Office.

U.S. Department of Defense (1982). Profile of American Youth: 1980 Nationwide Administration of the Armed Services Vocational Aptitude Battery. Washington, D.C.: Office of the Assistant Secretary of Defense.

U.S. Department of Labor (1972). Handbook for Analyzing Jobs. Washington, DC: U.S. Government Printing Office.

U.S. Department of Labor (1991). What Work Requires of Schools: A SCANS Report for America 2000. Washington, DC: U.S. Government Printing Office.

Vygotsky, L.S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Havard University Press.

Waters, B. K., Barnes, J. D., Foley, P., Steinhaus, S. D., & Brown, D. C. (1988). Estimating the reading skills of military applicants: Development of an ASVAB to RGL Conversion Table (Final Report 88-22). Alexandria, VA: Human Resources Research Organization.

Watson, J. B. (1925). Behaviorism. New York: The People's Institute Publishing Co.

Wallace, M. & Kalleberg, A. (1982). Industrial transformation and the decline of craft: The decomposition of skill in the printing industry, 1931-1978. American Sociological Review, 47. 3, 307-24.

Zenyuh, J.P., Frey, P.R., Rouse, W.B., & Lamb, T.A. (1991). Iob-Aiding/Training Tradeoff Decision Methodology and Prototype Support System. (AL-TP-1991-0015). Brooks AFB, TX: Armstrong Laboratory.

APPENDIX A

Fundamental Skills Lists

Appendix A: FUNDAMENTAL SKILLS LIST

Transferable Skills: Communication Working with others Problem solving Analyzing/assessing Planning/layout Organizing Managing others Decision making Positive work attitudes	Workplace	Educators, personnel officers, trainers	Wiant, 1977
Basic skills conceptualized as "generalizable" skills: Mathematics Communications Interpersonal relations Reasoning	Public secondary voc ed/ postsecondary voc ed	Teachers	Greenan, 1983
Aptitude in verbal comprehension, arithmetic reasoning, manual dextarity Interest/temperament	Workplace	--	Greenan, 1984 (cites Mecham and McCormick, 1969)
Attributes: Ideation fluency Orginality Problem sensitivity Spatial orientation Reflective attention Time sharing Stamina Speed of limb movement	Workplace	--	Greenan, 1984 (cites Marquardt and McCormick, 1972)
Work elements: activities/ conditions Work attributes: abilities/ personality traits	Workplace	--	Greenan, 1984 (cites Cunningham, 1971)

Talents: Creative or productive thinking Evaluative or decision -making talent Planning Forecasting Communication	Workplace	--	Greenan, 1984 (cites Taylor, 1973)
Transferable skills: Intelligence Aptitude Interpersonal Attitudinal	Workplace	Conference participants	Greenan, 1984 (cites, Wiant, 1977)
Listening Speaking Verbal communication Job-related competencies Writing	Trade/industrial occupations	Community college/ technical institutes' administrators, vocational teachers, English teachers	Greenan, 1984 (cites Howell, 1977)
Handle unpredictable and nonroutine problems and circumstances Experience how generic principles and processes translate into specific work Values and attitudes regarding work: Cooperative working relationships Commitment to quality Social responsibility in creation and distribution of goods	Public secondary schools	--	Oakes, 1966

Participate in socially shared intellectual work Listen to and analyze arguments Gather information and know how to use it Reason, analysis, and reflection	--	--	Resnick, 1987b
Problem solving Knowledge acquisition Self-management	Secondary voc ed	--	Chipman, 1988
Troubleshooting Problem solving Communication Interoperability Motivation	--	Military	Garretson, 1988
Systematic and abstract knowledge Understand multiple arrays of info and rules governing them Understood relationships between arrays Frame answers to less standardized requests	Workplace	Claims adjusters	Shanker, 1988
Need to be adaptable to profit from changing workpaces: Set goals and develop/ implement strategies to achieve them Know how to learn new information and skills Use info contained in context and apply it to another Identify where and from whom to access info Solve problems Function as members o multiple work teams	Michigan workplace	Operations and human resource executives	Michigan Employability Skills Task Force, 1988

Skills for the modern workplace Initiative Cooperation Working in groups Peer training Evaluation Communication Reasoning Problem solving Decision making Obtaining and using information Planning Learning skills Multicultural skills	--	--	Raizen, 1989 (cites Levin, 1988)
Workplace adaptation skills (or" aspects"): Organizational Performance Interpersonal Responsibility Affective	Workplace	--	Greenan, 1984 (cites Ashley, Cellini, Fadello, Pearlson, Wiant, and Wright, 1980)
Consumer economic skills: Consumer power Money management Consumer finances Occupational adaptability skills: Good work attitude Manage one's own time and activity	--	General adult population	Greenan, 1984 (cites Seis, 1980; Selz and Coleman, 1980; Selz, Jones and Ashley, 1980)

Group problem-solving skills: Interpersonal Group process Problem solving Decision making Planning Communications Thinking/reasoning Organization and management skills: Business economics Business operations Management Statistical quality control Introduction to "quality of work life"	Workplace/ high-involvement work settings	Firms with known QWL reputation	Pratzer and Russell, 1984
QWL acitivites: Teamwork Cooperative diagnosis Cooperative problem solving (interpersonal relations/group process, communication, thinking, reasoning) Dealing with ambiguity and uncertainty Managing difference Making informed judgments about multiple outcomes and realities	Workplace	Firms with known QWL reputation	Pratzer and Russell, 1984
Thinking skills: "Use their heads at work" Acquire information Communicate Teamwork Active inquiry	Public secondary schools	–	Stern, Hoechlander, Choy, and Benson, 1985

Critical thinking skills: Recognition that a problem exists Definition of real-world, ill-structured problems Identify limited information and seek requisite information Understand that solution depends on context Define goals in ill-defined situations Group problem-solving skills	--	--	Sternberg, 1985
Legible handwriting Accurate, fast arithmetic calculation Spell common nouns Familiar with job names Understand/interpret info presented by phone alone Communicate an attitude of interest/helpfulness Perform simultaneous tasks Flexibility in changing work strategies under various supervisory/reward conditions Apply rules to new examples Apply multiple procedural rules in a classification task Listening and talking Construct learning/job aids to guide learning and performance	Workplace (broad range of occupations)	--	Greenan, 1984 (cites Short, Dotts, Short, and Bradley, 1974)
Adult literacy skills: Communication (read, write, speak, listen) Computational skills Problem-solving skills Interpersonal skills	Workplace	Adult	Greenan, 1984 (cites Northcutt, 1975)

To transfer skills to job: Task performance skills Skills to apply broad usable knowledge Personal/interpersonal effective skills Self-analysis skills Career management and productivity To apply broadly usable knowledge: Able to know where and how to access information Commit knowledge to memory Recall information accurately Identify information needed for occupational tasks Use knowledge in decision making and problem solving Create new knowledge as result of synthesising existing knowledge Occupational survival skills: Working in organizations Understanding self Motivation for work Interpersonal relations Effective communications Using creativity at work Coping with conflict Coping with change Adapting and planning for the future	Workplace	Training/ guidance programs focused on transferable occupational skills	Greenan, 1984 (cites Miguel, 1977)

APPENDIX B

JSEP Fundamental Skill Courses

Appendix B: JSEP FUNDAMENTAL SKILL COURSES

This appendix contains a list of the lesson series from the Curriculum Catalog for the Army's Job Skills Education Program (JSEP). Each of the first 41 series corresponds to a set of prerequisite academic competencies or skills. Each lesson of these series deals with a specific skill, and there are generally two to ten lessons in each series. In addition, there are four supplementary lessons covering a wide range of skills which may not be directly job related. The last series consists of five learning strategies lessons.

This list of lessons came from an undated manuscript entitled "The job skills education program: Issues and answers, by Beatrice J. Farr, Army Research Institute, Alexandria, VA.

Curriculum Catalog

NUMBERING AND COUNTING

This series contains nine lessons (01A -01I). Lower level skills include matching numerals with word names and models. Higher level skills are developed by matching numbers or points with intervals on scales that can be represented as a number line (with or without numbers).

LINEAR, WEIGHT, AND VOLUME MEASURES

Seven lessons (02A- 02G) make up the linear, weight, and volume measures series. Soldiers are instructed how to identify units of measure, weight, and volume. In addition, soldiers are instructed how to use existing objects or concepts to measures or estimate size or distance.

DEGREE MEASURES

In this series soldiers learn how to identify degrees and mils in determining angular measurement or temperature. The four lessons (03A - 03D) cover estimating the measure of a given angle, and interpreting bearings, azimuths, and other contexts in which the measure of an angle may range in mils or degrees.

TIME-TELLING MEASURES

This series contains six lessons (04A - 04F). Soldiers are given instruction on how to tell time, estimate time, convert time to hours and tenths of hours. More advanced instruction is provided on how to convert to ZULU (Greenwich Mean

Time) time, and to determine equivalent dates using Gregorian and Julian calendars.

GAGE MEASURES

Nine lessons are contained in the gage measure series (05A - 05I). Soldiers can complete lessons on how to read and interpret different types of gages. They can also receive instruction which explains how to match specifications of required measures by manipulation, alinement, and maintenance.

SPATIAL

The spatial series contains four lessons (06A - 06D). An objective of this series involves instructing soldiers how to relate symbols and graphic representations to actual systems, subsystems, and components.

LINES

Through the course of five lessons (07A - 07E) soldiers are given instruction on how to identify and draw the following: points, lines, parts of lines, rays, vertical lines, horizontal lines, diagonal lines, intersecting lines, divergent lines, perpendicular lines, and parallel lines.

PLANES

Five lessons comprise the planes series (08A - 08E). In this series, soldiers receive instruction on the identification of plane geometric shapes and characteristics. They also learn how to match patterns of figures both actual size and model drawings.

ANGLES AND TRIANGLES

In the angles and triangles series (09A - 09E), soldiers practice how to identify the following: vertical angles, horizontal angles, supplementary angles, and types of triangles. More advanced skills help the soldier to learn how to name angles by using letters and numbers, and to identify altitudes and bisectors of angles and triangles.

SOLIDS

This series involves instructing soldiers how to recognize and match names of solids with their corresponding figures (10A).

TERMINOLOGY

The terminology series contains two lessons (11A and 11B). Soldiers are given instruction on identify shape and position terms, and spatial orientation terms with positions.

ADDITION AND SUBTRACTION

The addition and subtraction series contains eight lessons (12A - 12H). The content provided in these lessons gives the soldier practice in adding and subtracting whole numbers and decimals with or without carrying and borrowing. Also included are lessons which cover adding and subtracting 24 hour time, and estimating a sum or difference.

MULTIPLICATION AND DIVISION

Five lessons (13A - 13E) are contained in the multiplication and division series. Soldiers are given instruction on how to multiply and divide whole and decimal numbers, and negative and positive numbers. Higher level skills involve estimating a product or quotient.

FRACTIONS/DECIMALS

The fractions/decimals series contains lessons from 14A through 14G. In this series, soldiers can complete lessons which provide instruction on how to add, subtract, multiply, divide, and reduce fractions to lowest terms. These skills are further developed in the series in lessons which help the soldier to learn to convert fractions to decimals, and to convert decimals and percentages to fractions and vice versa. More advanced lessons are those where the soldiers receive instruction on how to estimate fractional lengths, distance, area, volume, and fractional sums, products, and quotients.

GEOMETRY

The geometry series contains ten lessons (15A - 15J). These lessons help the soldiers to learn how to label, match, and draw, plane geometric figures. They also complete lessons on how to use a protractor to construct perpendicular lines.

Higher level skills concentrate on the use of formulas to solve problems involving geometric figures, and solving problems using oscilloscope readouts.

COMBINATION OF PROCESSES

Eight lessons comprise the combination of processes series (16A - 16H). In this series, soldiers compute averages, solve problems combining all processes, and identify and interpret information which can be used to solve arithmetic problems. The higher level skills taught in this series are conversion problems, problems involving ratio and proportion, and word problems involving any mathematical process.

GRAPHING IN THE COORDINATE PLANE

The graphing in the coordinate plane series is comprised of three lessons (17A - 17C). Soldiers are given instruction on how to identify grid coordinates on a military map, specify the eight digit coordinates of any intersection of lines, and how to plot a point at an intersection of a grid when distance and direction are specified.

ALGEBRA

Three lessons (18A - 18C) are contained in the algebra series. In this series, soldiers receive instruction on how to solve algebraic equations with one unknown, to derive equivalent algebraic equations, to use formulas to solve problems. They also learn how to calculate power and square root with a pocket calculator presented on the screen.

TRIGONOMETRY

The trigonometry series is comprised of four higher level lessons (19A - 19D). Soldiers learn how to use tables of trigonometric functions in mils and degrees. Also provided are lessons on how to use tables of logarithms to solve multiplication and division problems, and to use trigonometric functions to solve geometric problems. The soldiers can also complete a lesson which explains how to calculate the length of a side of a triangle.

PROCEDURAL DIRECTIONS

The six lessons that comprise the series on procedural directions (25A - 25F) give soldiers practice on how to follow directions or synthesize information to complete a task activity or sequence of task activities. In addition, soldiers receive instruction on how to select the appropriate course of action in a specified situation, and how to

determine the essential message of job-related material.

VOCABULARY

The vocabulary series consists of seven lessons (26A - 26G). In this series, soldiers can learn to recognize the meaning of common words, aircraft and tank related words, communication and navigation related words, and rifle and survival related words. They can also learn to identify the correct meaning of a word from the context of a sentence, and learn to determine the meaning of figurative and idiomatic terms.

REFERENCE SKILLS

Seven lessons make up the reference skills series (27A - 27G). The lower level skills relate to how to locate documents by code number and title, file information alphabetically and alphanumerically, locate information in a book or manual to solve a problem. To develop these skills further, soldiers can complete lessons on how to skim or scan for relevant information, how to use cross references to locate information, and how to organize information from multiple sources.

TABLES/CHARTS

The series on tables/charts contains four lessons (28A - 28D). Instructions is provided for soldiers methods for obtaining a fact or specification from a two-column chart or tables, or from an intersection of a row-by-column table or chart. Soldiers can complete lessons on using cross-referencing within or in combination with text material outside the chart or table. They also learn to locate malfunctions or select a course of action based on information from tables or charts.

ILLUSTRATIONS

In the series on illustrations, seven lessons (29A - 29G) help soldiers learn how to identify details, labels, numbers, and parts from an illustration or according to a key, legend, or list. In addition, instruction is given which provide soldiers with practice in using a cross-sectional view of an object for decisions and assembly or disassembly. Further development of the skill is done in lessons which use illustrations or sequences of illustrations to follow directions and to integrate visual information from various sources to select a course of action. Included in the series is a lesson which helps the soldiers use a map to identify and communicate details of terrain or layout.

FLOW CHARTS

Three lessons (30A - 30C) comprise the series on flow charts. In this series, soldiers learn to identify the meanings of symbols on a flow chart, to use a flow chart to make procedural decision, and to identify organization members.

SCHEMATICS

The series on schematics consists of five lessons (31A - 31E). In this series, instruction is given on how to identify subsystems of block, schematic, and wiring diagrams. Additionally, soldiers learn how to identify components and signal paths of a symbolic configuration, and to trace circuit connections from one designated point to another within a schematic diagram. Higher level skills help the soldiers to identify possible faulty components of a subsystem using a troubleshooting table.

FORMS

The forms series is composed of five lessons (32A - 32E). In this series, soldiers can practice locating block on a form to enter appropriate information, and transferring a number, code, date, figure, from equipment or written sources onto an appropriate section of a form. In addition, soldiers learn to write the names of the organization, responsible personnel, disposition of the part of equipment, and nomenclature, in appropriate sections of a form. More advanced skills help the soldiers develop the ability to write a descriptive account of an activity or transaction performed, and to use a completed form to locate or compare information.

NOTE-TAKING

Four lessons are contained in the note-taking series (33A - 33D). The lessons in this series help soldiers to develop the skills to record essential information, record information in sentence form, and record information that involves more than one sentence. Lessons also provide instruction on how to assure accuracy and precision when recording information.

SERIES: OUTLINING (topic or sentence)

The outlining series involves five lessons (34A 0- 34E). These lessons give soldiers instruction on how to identify the main ideas in a situation or event, and how to recognize titles for each section of an outline. Soldiers also learn to select appropriate details to support the main topic, and learn to use numbers and letters to label the topics in an outline. To accurately assess this skill the final lesson is paper-based in which the soldiers write a training outline.

REPORT WRITING

Ten paper-based lessons are contained in the report writing series (35A - 35J). The lessons provide instruction and practice in summarizing the essential details of a report by answering the questions who, what, where, when, and how, to instructing the soldier to write a report that justifies actions taken and provides good reasons for rejecting alternative actions.

EDITING

The editing series contains eight lessons (36A - 36H). In the editing series soldiers learn how to spell frequently used words and task-related words correctly, and to identify words that need to be capitalized. In addition, instruction on how to use a reference source to correct misspellings, and to apply common rules of grammar is provided. The final lessons in the series is paper-based. The soldiers practice how to rewrite a paragraph, and how to appraise a written communication and how to make adjustments to improve clarity.

PRECAUTIONS

The three lessons in the precautions series (40A - 40C), help soldiers learn to use common knowledge to prevent injury to people or equipment. In addition, soldiers learn to apply preventive measures to minimize potential safety or security problems. Soldiers can learn to identify the appropriate course of action to take in specific emergency situations.

SERIES: RECOGNITION

The recognition series is comprised of eight lessons (41A - 41H). In the recognition series, instruction is provided on how to identify objects by the descriptive name and use, identify damage to or defects in equipment, and to identify objects by size, shape, color and markings. Soldiers receive instruction and practice on how to use and interpret hand and arm signals, and to interpret and use symbols and codes.

SUPPLEMENTARY LESSONS

Supplementary lessons cover a wide range of skills that may or may not be directly related to the soldiers' job in the Army. Skills presented in these four lessons (42A, 43A - 43C) are thought to be of general use in a variety of life situations. For example, lesson topics include prevention and first aid for heat and cold related injuries, as well as maintaining a checking account.

LEARNING STRATEGIES

This series contains five lessons that are separate from regular JSEP Diagnostic Review and Skill Development lessons. The purpose for each learning strategies lesson is as follows: (1) Motivational Skills Training - to facilitate learner awareness and control of moods that affect learning; (2) Problem Solving - to provide a useful plan for identifying and solving math word problems; (3) Reading Strategies - to promote comprehension and retention of written materials; (4) Test Taking - to increase test-taking performance via useful test taking activities; and (5) *Time Management - to encourage activities for forming and carrying out goals related to taking JSEP lessons.

*Time Management is the only "required" Learning Strategies Lesson. The procedure for prescribing the other four lessons are detailed in the JSEP Instructors Manual.

APPENDIX C

Job Analyses Methods

Appendix C: JOB ANALYSIS METHODS

Several different methods and approaches can be used to conduct a job analysis. Which method and approach is most appropriate depends on several aspects of the particular analysis situation. The following review of methods provides an introduction to selected key methods as background to the comparison of methods that appears in the main body of this paper.

Observation

Observation methods vary in degree of structure and observer involvement (participative to nonparticipative). Participant observation, or ethnography, is a field research strategy that simultaneously combines analysis of documents, interviewing of incumbents, direct participation and observation, and introspection (Denzin, 1989). This requires the submersion of the observer in the data and the use of analytic induction and theoretical sampling as the main analytic strategies. This research design is deliberately unstructured so as to maximize the discovery and grounding of theoretical interpretation. The intent is to continually revise and test emergent hypotheses as the research is conducted. It is the primary method used in cultural research and is widely used in sociological research.

In participant observation, interviews are typically open-ended and unstructured, and observation of ongoing events is usually less concerned with reporting the frequency and distribution of activities than it is with linking interaction patterns with the symbols and meanings underlying behaviors. Rich description and interpretation are central to the development of understanding that emerges from ethnographic studies of groups or organizations. The description attempts to capture the meanings, actions, and sensations present in an interaction. It also strives to record how interpretations unfold during the interaction. The interpretation, in turn, attempts to explicate the essential features of the interaction experiences that have been described. According to Denzin (1989), perhaps more than other methods, the participant observation approach stresses understanding the experiences of those studies.

A central assumption of participant observation is that the investigator(s) share as intimately as possible in the activities and tasks of those under study. This involves partaking in as many of their activities as practical. By drawing on shared experiences, which can only come after one has deeply entered the subjects' world, the observer can develop insights and understanding that would not otherwise be possible. Participant observers must convince those they are studying to accept them and allow them to question and observe.

The participant as observer, unlike the complete participant, makes his or her presence as an investigator known and attempts to form a series of relationships

with the subjects such that they serve as both respondents and informants. Informants are persons who, ideally, (1) trust the investigator; (2) freely give information about their problems and frankly try to explain their own motivation; (3) demonstrate that they will not jeopardize the study; (4) accept information given them by the investigator; and (5) provide data and aid that could possibly jeopardize their own position.

The role of investigators using this strategy passes through several stages through time. At first, the researcher is treated as a stranger, and initial encounters are usually superficial. Once the observer-observed relationship is well established, the observer moves into a phase where he or she is accorded the status of provisional member. Respondents may ask why they were selected for study. The observer tries to teach the respondents how to act toward him or her. This includes convincing them of the confidentiality of their conversations, as well as getting them to accept the presence of an observer during their daily routine of duties. In the last stage, the observer is accepted as a "categorical member" of the organization. Rapport has already been established, areas of observation have been agreed upon, and the roles of observer and observed are well-defined.

Nonparticipative observation is a more structured job analysis technique where someone other than the incumbent observes and records the incumbents behaviors. The choice of an observation method depends on considerations such as time, cost, unit of analysis (target), and types of behavior of interest. The target of observation might be individuals, dyads, groups, organizations, or some combination of these.

In addition to depth of analysis and contextual information, observation methods are flexible and have high face validity. Understandably, there are limitations associated with firsthand observation. The method usually is time-consuming and expensive. Therefore, sample sizes are usually small. Observation does not afford a high degree of control: an analyst observes what he or she has an opportunity to observe over a given period of time. Some covert behavior such as cognitive processes cannot be readily observed. And, issues of data contamination and inadvertent editing by choice of observations are common concerns of all observation methods. More structure usually results in higher reliability, but not necessarily higher validity. The key is to know when additional confirming data probably are required.

Interview

A job analysis interview is a meeting, usually face-to-face, between two or more people for the purpose of exchanging information about a job or jobs (Gael, 1983; 1988). Most job analysis interviews are structured and are conducted in an isolated site away from the job location. Interview data is often combined with information obtained through other job analysis techniques. If only a few incumbents who work nearby hold the job of interest, interviewing can be a sole and sufficient methodology.

One of the most frequent uses of interviewing in job analysis is for the preparation of questionnaires. Three types of interviews have proven useful in compiling lists of job activities prior to development of a job task inventory questionnaire. These are:

1. Initial Interview. This provides a large part of the information from which task statements will be prepared, especially when job documentation is scarce. The first interview should be guided by task information extracted from other sources.

2. Verification Interviews. This serves as a check and aid in modifying all information obtained. Any pertinent data overlooked previously can be obtained at this point.

3. Follow-up interview. This is a group interview with incumbents and superiors to review, modify if needed, and edit each task statement in a draft of the task list.

If practical, initial and verification interviews should also be conducted for incumbents at two locations to check for site variations. Interviewees should be experienced incumbents and supervisors who have current knowledge of the job. Prior to interviewing, the analyst should review available information in order to determine what additional data are needed and what needs to be clarified or verified. Interviewees should be informed about the purpose of the interview and asked to bring specified work-related materials. The latter can generate discussion of accomplishments and items that initiate work activities.

Interviews share many of the same advantages and disadvantages of observation methods. The detail that can be achieved is enhanced by the ability to prove and discuss. Covert information such as cognitive processes can be discussed. However, leading questions and other inadvertent prompting can bias responses. Lack of control and cost are also problems, but these are less severe in interviews as compared with observation techniques.

Functional Job Analysis

Functional Job Analysis (FJA) is a method of examining and understanding a job from the standpoint of purpose and functions (Fine, 1974; 1988). All work has a specific purpose in which something is to be accomplished that meets certain standards. Correspondingly, the worker must have certain functional and specific content skills in order to get the job done. Also, all work involves a worker adapting to the environment in order to satisfy individual work-related needs. Of particular relevance to this research, the FJA technique resulted from efforts by the Department of Labor to classify jobs on the basis of worker attribute requirements.

The two key components in FJA are what the worker does and what gets done. What the worker does is captured in Worker Function Scales and three types of skills. What gets done is defined as tasks, the fundamental unit of work in FJA.

The three Worker Function Scales are labeled Things, Data, and People. These are the classes of entities, one or more of which are involved in any work task. For each scale, there is a hierarchy of actions or behaviors which are ordered in terms of increasing complexity.

The three types of skills are defined as follows:

1. Functional skills. Competencies that enable an individual to relate to worker functions according to level of mental (reasoning, math, language), physical, and interpersonal abilities and preferences.

2. Specific Content skills. Competencies that enable an individual to perform a specific job according to set standards (these include skills and knowledges involving procedures, machines, and the equipment).

3. Adaptive skills. Competencies that enable an individual to manage demands for conformity and/or change in relation to conditions in which a job exists (these include behavioral styles concerning schedules, authority, interaction, appearance, and impulse control).

In FJA, task statements for a job are generated that have the following structure:

- Behavior/Action
- Object of Action
- Source of Information
- Nature of Instruction
- Equipment, Tools
- Result

When tasks are written in this manner and contain the information indicated, then, with a minimum of interface, one can derive directly the performance standards and training content, both functional and specific, required for satisfactory performance. The result part of a FJA task statement reflects the objectives of the work. The combined results of tasks, in turn, contribute to the goals and purpose of the work organization.

In doing a FJA, task statements are written by SMEs with the guidance of a trained analyst. In addition to performance standards and training content, the task statements include ratings of levels on the Worker Function Scales and functional mental skills. Revised task statements are then administered in an inventory to all available incumbents. Ratings are elicited on whether incumbents perform the task, frequency, criticality, and importance.

In an evaluation of alternative methods (Levine, Ash, Hall, & Sistrunk, 1983), FJA was rated high or highest on many criteria. It was rated high on occupational versatility/suitability, acceptability, quality of outcome, operationality, cost-effectiveness, and time to train analysts (i.e., quick to train). Also, it was rated high on use for all purposes. It was rated moderately on reliability, but low on standardization, usability "off the shelf", and quick to do. Also, a data base of FJA job analyses, organized by Dictionary of Occupational Titles (DOT) titles has been compiled.

The Position Analysis Questionnaire

The Position Analysis Questionnaire (PAQ) is a structured job analysis questionnaire consisting of 187 worker-oriented job elements about activities and work situation variables (McCormick, Jeanneret, & Mecham, 1972; McCormick & Jeanneret, 1988). It is possible to use in the analysis of most jobs because it is generic.

The PAQ was designed primarily for the two purposes of estimating aptitude requirements of jobs for use in personnel selection, and dollar values of jobs for use in wage and salary administration. The PAQ follows the "job component" approach, involving the strategy of: (a) defining a universal set of job descriptors, or components, applicable to the entire job population, and then (b) establishing the human aptitude requirements of those components. Using this worker-oriented approach, aptitude-requirement estimates can be derived for any job (conceptually) that has been profiled on the components.

The PAQ job elements are organized into six divisions:

1. Information Input. Where and how the worker gets the information that is used in performing the job.

2. Mental Processes. What reasoning, decision-making, planning, and information processing activities are involved in performing the job.

3. Work Output. What physical activities the worker performs and what tools or devises are used.

4. Relationships with Other Persons. What relationships with other people are required in performing the job.

5. Job Context. The physical and social contexts in which the work is performed.

6. Other Job Characteristics. What activities, conditions, or characteristics other than those described above are relevant to the job.

Each PAQ job element describes a general work behavior/activity, work condition, or job characteristic. These elements are based on factor analysis of 2,200

jobs. In addition to a factor or dimension corresponding to each element, 13 overall dimensions were obtained. These consist of general job type categories (clerical, technical, service, public contact, physical, supervisory activities), work environment aspects, and schedule/routine aspects.

Job families based on similar PAQ profiles can be obtained easily using a computer-generated index of similarity and a clustering program. A set of estimated aptitude test data also is provided as part of the standard computer output. The tests are the nine subtests of the General Aptitude Test Battery (GATB).

In two evaluations of alternative methods (Lavine, Bennett, & Ash, 1979; Levine, Ash, Hall, & Sistrunk, 1983), the PAQ was rated high or highest on most criteria. It was rated as most reliable, standardized, usable "off the shelf" cost-effective, and quick to do. Also, a database of PAQ job analyses, organized by DOT titles has been compiled. The PAQ was rated somewhat lower than several other methods on the criteria of suitability for content validity, performance appraisal, and worker training.

Managerial and Professional Job Functions Inventory

The Managerial and Professional Job Functions Inventory (MP-JFI) is a job-oriented instrument designed to measure work behaviors underlying higher level positions (Baehr, 1980; 1988). It is a revision of the Work Elements Inventory, which, like the MP-JFI, was based on factor analysis of questionnaire items. The PM-JFI contains 140 items covering 16 job function dimensions. The items are generic in the sense that they do not specify or imply any specific occupations or departments such as sales or research and development. The job function dimensions are grouped into four areas as follows:

1. Organizational. This includes setting organizational objectives, financial planning and review, improving work procedures and practices, and inter-departmental coordination.

2. Leadership. This includes developing and implementing technical ideas, judgement and decision making, developing group cooperation and teamwork, coping with difficulties and emergencies, and promoting safety attitudes and practices.

3. Human Resources. This includes developing employee potential, supervisory practices, self-development and improvement, and personnel practices.

4. Community. This includes promoting community-organizational relations and handling outside contacts.

National norms based on importance ratings have been developed for three levels of occupations (executives, middle managers, and supervisors/professionals/ technical specialists) in four hierarchies (line, professional, sales, and financial).

To establish a link between individuals' skills and attributes needed for successful performance, and the MP-JFI job functions, a managerial and professional test battery was developed. This consists of ten psychological tests and questionnaires which provide 44 scores. Based on more than 60 validation studies, the scores on the specific combinations of test measures that predict performance in the various occupational groups are used to develop a single score that represents the estimate of Potential for Successful Performance in the position.

The MP-JFI has application to officer and some senior NCO duties, and also is generic (to managerial/professional positions), but due to this higher level focus, it is not generally applicable nor practical for the determination of AF fundamental skills requirements.

Threshold Traits Analysis System

The Threshold Traits Analysis System (TTAS) is a worker trait-oriented job analysis technique designed to identify those personal characteristics required to perform the functions of a specific position. It is possible to use it in the analysis of most jobs because it is generic. The TTAS traits are organized into five areas:

1. Physical. Includes strength, stamina, agility, vision, and hearing.

2. Mental. Includes perception, concentration, memory, comprehension, problem-solving, and creativity.

3. Learned. Includes numerical computation, communications, planning, decision-making, craft knowledge, and craft skill.

4. Motivational. Includes adaptability/adjustment to several working conditions, self-control, initiative, perseverance, and aspirations.

5. Social. Includes personal appearance, interpersonal tolerance, interpersonal influence, and cooperation.

There are a total of 33 traits in the TTAS. Each trait is rated on level of complexity using three or four levels. The final trait level computed for a trait is strongly influenced by practicality ratings. Practicality refers to the proportion of job applicants who can reasonably be expected to possess a given trait at each level. If less than one percent of job applicants are expected to possess the level specified for a trait, the trait is eliminated as a requirement.

The TTAS methodology includes three complementary analyses: Threshold Traits Analysis (TTA), Demand and Task Analysis (DATA), and Technical Competence Analysis (TCA). In TTA, supervisors, other SMEs, and/or job incumbents determine the relevancy, level, and practicality of each of the 33 traits for acceptable and superior job performance. For TTA ratings, at least five trained analysts (usually first-line supervisors) are used.

The DATA technique involves a specific job description questionnaire that includes statements on job tasks and demands. Incumbents complete the questionnaire by indicating on a 7-point scale which statements represent significant (4) or critical (7) activities for the job position. Each statement is associated with a single trait.

Technical Competence Analysis (TCA) is done only on those jobs requiring specific craft knowledge and/or craft skill. Skills are defined as psychomotor activities involving both body and brain that are acquired only through practice. The TCA starts with a questionnaire similar to that in DATA. Relevant statements are then judged by SMEs (approximately 10 are used) on whether the knowledge or skill is required upon job entry (first-day application) and are performed without supervision. The SMEs may also be asked at what point mastery is required (number of months on the job). The outcome of the TCA is a Technical Competence Specification organized by content domain, listing the statements with knowledge/skill requirements. The TTA and DATA results are compared for consistency and can be combined to yield a more accurate and complete picture of a job.

In an evaluation of alternative methods by 93 job analysts (Levine, Ash, Hall, & Sistrunk, 1983) TTAS was rated relatively low on most criteria. It was rated high on occupational versatility/suitability and time to complete (i.e., quick to do). Also, it was rated high on use for personnel requirements/specifications. The TTAS has been criticized as being overly complex and somewhat impractical. Approximately 100 job analysis studies using TTAS have been reported.

Ability Requirements Approach

The Ability Requirements Approach is a worker/attribute-oriented methodology for linking descriptions of job tasks to the generic abilities required in performing these tasks (Fleishman, 1972; Fleishman & Quaintance, 1984; Fleishman & Mumford, 1988). Abilities are viewed as relatively enduring attributes of the individual that influence a wide range of task performances. These abilities include, for example, verbal comprehension, spatial visualization, and psychomotor. It is assumed that specific tasks require certain abilities, and these ability categories can be used to describe and summarize a variety of tasks. For example, tasks requiring similar abilities could be placed in the same classification category.

This approach has led to the development of the Abilities Requirement Scales (ARS) for job analysis. The primary use of the ARS is to identify and provide information on the characteristics of job incumbents that affect task performance. By focusing on summary descriptions of tasks via characteristics used to explain performance in specific situations, the ARS approach generates a generic descriptive framework which can be applied to any number of jobs.

A review was done of factor analytic studies in which tasks were designed specifically to tap hypothesized ability categories derived from the literature and/or observational considerations. These tasks were then administered to individuals, and their scores subjected to factor analysis. The resulting factors were used to define and infer categories of abilities that summarize performance on a variety of tasks. These studies provided well-documented evidence describing the ability categories that describe human task performance. Abilities found were reviewed and defined by trained psychologists. The abilities present in 10 or more studies were combined into a single list.

A recent list of the Ability Requirement Scales (Fleishman & Mumford, 1988) included 50 abilities which can loosely be grouped into the following classes:

1. Cognitive. Approximately 15 abilities, most of which are traditionally found in aptitude batteries, including verbal (oral and written) and numerical reasoning, comprehension, expression, and mental flexibility.

2. Perceptual and related information-processing. Includes approximately six abilities such as Perceptual Speed, Selective Attention, Depth Perception and Time Sharing.

3. Psychomotor. Includes approximately 10 dexterity, control, speed, and coordination abilities.

4. Physical. Includes approximately 12 strength, stamina, gross body, and physical flexibility abilities.

5. Sensory. Includes approximately eight visual and auditory sensing abilities.

Once the abilities were identified, the next step was rating the extent to which each ability was required to perform various tasks. Behaviorally Anchored Rating Scales (BARS) were constructed by a group of psychologists familiar with the abilities. Another group of trained judges rated over 1,000 tasks on the degree to which each ability was required. Task examples with consistent low, medium, and high ratings for each ability were selected to anchor each Ability Requirement Scale.

The 50 anchored scales have been assembled into a Manual for Ability Requirement Scales (MARS). In a typical ARS job analysis, job or task descriptions are reviewed to identify important tasks that are then rated by incumbents or

supervisors using the MARS. The average ability scale values provide a profile at the job or task level.

The use of a common and stable descriptive framework, such as the ARS, is an essential requirement for the definition of meaningful job families or career fields. Application of the ARS approach allows the user to draw on a large base of prior research on abilities.

In the Levine, et al., evaluation (1983), the ARS was rated relatively low on many criteria. However, it was rated high on occupational versatility/suitability, time to train analysts (i.e., quick to train) and time to complete (i.e., quick to do). Also, it was rated moderately high on use for personnel requirements/specifications. The ARS has been criticized as being somewhat unreliable and impractical. However, a large number of job analysis studies have used some of the abilities contained in the ARS.

Critical Incident Technique

The Critical Incident Technique (CIT) is a method for obtaining specific, behaviorally focused descriptions of work activities, (Flanagan, 1954; Bownas & Bermardin, 1988). It was created in the Aviation Psychology Program of the Army Air Corps during World War II and was originally used in developing selection standards for aviation personnel. In that first application of CIT, groups or individuals recalled specific behavioral examples or incidents that reflected exceptionally good or poor ("critical") performance. The CIT method can be used to identify and describe critical job tasks, but the most common applications are in training needs assessment and performance appraisal.

A well-written critical incident is specific, focuses on observable behavior occurred, and it indicates the consequences of the behavior. An incident is "specific" if it describes, in detail, a single behavior. It must be sufficiently complete for a person knowledgeable about the job to picture an incumbent displaying that behavior. Incidents should be written in active voice, with an incumbent as the subject and a behavioral verb as the predicate. If possible, the incident should describe visible, external actions rather than internal events or omissions. The incident should describe the action's context in order to make sense, and, most importantly, to make it apparent whether the behavior was effective or not. To be complete, incidents must include some description of the consequences of the actions, since the conclusion about how effective a worker's behavior is derives from the results of the action.

Three methods are commonly used to identify critical incidents: workshop conference (focus groups, observation/interview, and surveys. Regardless of the method, the objective is to assist job experts recall and document behavioral examples illustrating job performances. The most frequently used procedure is a workshop or conference, attended by 6-12 "job experts", and supervised by someone

with knowledge of critical incidents and how they are to be used. It helps at the beginning of the workshop to distribute an example of the final product (e.g., a performance rating scale for a familiar job) and examples of correctly and poorly written incidents. The incident examples should be discussed, and practice writing additional examples should be included.

The approach in recalling and recording incidents can be structured or unstructured. A structured procedure is to distribute preprinted forms for use in recording. If an unstructured approach is taken, a brief, but comprehensive set of instructions should be developed, including an outline of the pieces of information to be contained in each example incident. One variation is for the leader to guide participants through a discussion of examples and tape record comments for later transcription.

The confirmatory step in critical incidents job analysis is retranslation. This step reconfirms the distinctiveness of the job dimensions that were identified during the content analysis, and evaluates and refines the writers' judgments of the effectiveness levels represented by the behavioral examples produced. Retranslation requires that each incident be read and rated by job experts similar to those who wrote the incidents. Two set of ratings are completed. First, the raters indicate to which category or job dimension each incident belongs. Second, they estimate the level of effectiveness illustrated by the behavior described.

The categorization ratings are evaluated to identify incidents that are so ambiguous that there is no consensus about the aspect of performance illustrated, and to identify dimensions similar enough to warrant combining. In evaluating effectiveness ratings of incidents, two requirements are needed. The first is rating invariance or consistency. Low rating variance for an incident reflects good rater agreement on the effectiveness of the behavior. The second is coverage of the entire range of effectiveness of each category or dimension of behavior. There should be at least one incident located at or near each major level of performance.

Unlike most of the other techniques in this review, the CIT is not a generalized job analysis method; however, the CIT provides a high level of behavior detail useful in performance appraisal, job design, and training needs analysis. The detail limits the generalizability of CIT products. The method usually cannot be used for more than one occupation, and is often organization specific. The CIT is also a time and labor intensive methodology.

Generic Skills Approach

A job analysis application involving generic skills was developed by the Department of Manpower and Immigration, Saskatchewan, Canada (Kawula & Smith, 1975). The objective of this project was to identify skills requirements common to a variety of jobs. A total of 76 jobs were surveyed via on-site interviewers using a questionnaire. Data were collected on the frequency of specific skills

and the importance of these skills to overall job performance. A taxonomy was developed for skills required at a number of job sites. For each category of skills, instructional/performance objectives were specified.

The taxonomy of common job-related skills encompasses the following areas:

1. Mathematics. Includes 60 objectives for 11 skills dealing with whole numbers, fractions, decimals, percents, mixed operations, measurement/calculation, algebra, metric scales/conversion, geometric figures, and graphs.

2. Drawings. Includes six objectives dealing with reading, measurement, and production of assembly, schematic, or shop drawings.

3. Verbal skill. Includes 40 objectives for 12 reading, listening, writing, and speaking skills dealing with various topics and materials.

4. Information organization. Includes four objectives dealing with sorting, ranking , and classifying data and objects.

5. Tools, equipment and materials. Includes four objectives dealing with selection or analysis to tools, equipment, and materials.

The methods and results of the Generic Skills study were utilized in the Audit Competency Education Project of San Mateo County Office of Education (Cooney, 1978). In this training project for unskilled or semi-skilled adults, 100 target jobs in the county were studied. An incumbent for each job was interviewed, using the questionnaire from the Generic Skills study. Questions were added to collect data on the context in which skills were used.

Copies of job-related manuals, forms, and other materials were obtained for use in training. Based on the analyses, a curriculum was developed for each job. Twenty to forty "competencies" were written for each job. Competencies contained: (1) the reason the skill is required (the skill in a job-related task); (2) a measurable instructional objective defining the skill; and (3) a job-related task for testing a student's ability at the skill.

This methodology has been primarily used within Canada's government agencies to (1) identify those skills that are common to a number of jobs, and (2) to identify the transferability of skills from one job to another. A primary application has been to identify, for individuals trained in one vocation, those jobs to which he or she can readily transfer because the new job has skills requirements essentially similar to the requirements of the previous job.

In general, the skills lists used in their analysis appear to be oriented to entry-level trades, labor and technician jobs. The existing instruments appear to only tap a portion of AF jobs.

Job Components Inventory

The Job Components Inventory (JCI) (Banks, Jackson, Stafford, & Warr, 1983; Banks, 1988) is a recent technique that has been strongly influenced by the Generic Skills work of Kawula and Smith (1975) and the PAQ job analysis techniques. The JCI was initially designed for vocational training uses. It is a worker-oriented inventory consisting of six main sections and an introductory section for identification and demographic information on the job and job incumbents. The main sections are:

1. Tools and pieces of equipment. These items are on the use and purpose of 220 pieces of equipment.

2. Physical and perceptual skills. These items deal with frequency of use of 23 skills involving physical strength, dexterity, speed, coordination, or attention.

3. Mathematical skills. These 127 items cover frequency of use of arithmetic, measurement, elementary geometry, algebra, and trigonometry skills with practical applications.

4. Communication skills. These 22 items deal with frequency of sending and receiving oral and written communications and interactions.

5. Decision-making and responsibility. These 9 items are on frequency of decision, methods, standards, and scheduling of work.

6. Job conditions. These consist of items on job characteristics and conditions.

The usual procedure in completing the JCI is for a trained interviewer, after familiarization with the job and workplace, to read the JCI items to job incumbents and record the responses.

The JCI has been used mostly for identifying eduction and training requirements for vocational-level jobs in the United Kingdom. It is especially suited to entry-level positions without high verbal literacy requirements.

Task Inventory/CODAP

The job-task inventory approach is a systematic work-oriented job analysis method of collecting information from incumbents and supervisors, and analyzing, organizing, and reporting quantitative results to managers (Christal, 1974; Christal & Weissmuller, 1988). A job-task inventory is a questionnaire with two main sections,

background, and task inventory. The background information section contains general identification and demographic classification items, and checklist questions pertaining to things that might appiy to the job or job training. The latter might include, for example, tools and equipment used, training courses taken, and attitudes towards the job. The task inventory section is a listing of the tasks arranged under broad duty sections. The format of each task statement consists of an action, an object of the action, and essential modifiers. Completed questionnaires are analyzed via the Comprehensive Occupational Data Analysis Program (CODAP) developed by the Air Force Human Resources Laboratory.

Initial task lists are usually compiled from written job descriptions, training materials, and operational manuals. Supervisors and trainers are then used in revising the task list, which will often contain 400-600 tasks. The resulting job-task inventories are then distributed or mailed to job incumbents and supervisors. Job incumbents are asked to check tasks performed and to indicate, on a nine-point scale, the relative time spent on each task performed. The relative time spent ratings for each individual are revised by CODAP to reflect percent of total work time spent on each task.

In addition to time spent, supervisors (senior enlisted and officer personnel) also are asked to rate task factors such as training emphasis or task difficulty of each task. Training emphasis is rated on a ten-point scale from "no structured training required" to "extremely high training emphasis." Task difficulty is defined as the length of time it takes an average incumbent to learn to do the task. This is rated on a nine-point scale from "extremely low difficulty" to "extremely high difficulty."

Among the many CODAP applications are computer programs for data input/formatting, describing jobs of specified groups of workers, comparing work performed by specified groups, identifying and describing types of jobs in an occupational area, describing characteristics of jobs and tasks, and statistical outputs such as interater reliabilities, correlations, and regression analyses.

Two especially noteworthy applications of CODAP are job learning difficulty and job clustering. The first step in obtaining job learning difficulty is computing Average Task Difficulty Per Unit Time Spent (ATDPUTS). This is the prorated product of average task difficulty and percent time spent for each task. The overall difficulty of learning the job is then computed by combining the ATDPUTS values with number of tasks performed in a regression equation. A hierarchical clustering program calculates the similarity of jobs for which a common task inventory has been administered. An iterative procedure is used in which the two most similar jobs are combined. Then the next two most similar jobs or job groups are combined. This procedure continues until only two groups remain. At each step, a goodness of fit statistic is computed to guide selection of the best solution.

In the Levine, et al., evaluation of alternative methods (1983), TI/CODAP was rated high or highest on most criteria. It was rated as most reliable and

standardized, high on occupational versatility/suitability, user acceptability, and cost effectiveness. Also, a database of several hundred job analyses, organized by Air Force specialty code has been compiled. The TI/CODAP method was rated somewhat lower then several other methods on the criteria of quick to train analysts, usable "off the shelf", quick to do, and suitable for personnel requirements/ specifications.

REFERENCES

Baehr, M. E. (1980). Evaluation of potential for successful performance in higher-level positions (Research Report No. 2). Chicago: The University of Chicago, Human Resources Center.

Baehr, M. E. (1988). The managerial and professional job Functions inventory (formerly the work elements inventory). In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol II, (pp1072-1085). New York: Wiley.

Banks, M. H. (1988). Job Components Inventory. In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol II, (pp960-975). New York: Wiley.

Banks, M. H., Jackson, P. R., Stafford, E. M., & Warr, P. B. (1983). The job components inventory and the analysis of jobs requiring limited skill. Personnel Psychology, 36, 57-66.

Bownas, D. A., & Bernardin, J. (1988). Critical Incident Technique. In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol II, (pp1120-1137). New York: Wiley.

Christal, R. E. (1974). The United States Air Force Occupational Research Project (AFHRL-TR-73-75). Lackland AFB, TX: Occupational Research Division.

Christal, R. E., & Weissmuller, J. J. (1988). Job-task inventory analysis. In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol II, (pp1036-1050). New York: Wiley.

Cooney, J. (1978). Linking math, reading, and writing skills to jobs, San Mateo County, CA: San Mateo County Office of Education.

Denzin, N. K. (1989). The research act (3rd ed.). Englewood Cliffs NJ: Prentice-Hall.

Fine, S. A. (1974). Functional job analysis: An approach to a Technology for manpower planning. Personnel Journal, 53, 813-818.

Fine, S. A. (1988). Functional Job Analysis. In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol II, (pp1019-1035). New York: Wiley.

Flanagan, J. C. (1954). The critical incident technique. Psychological Bulletin, 51, 327-358.

Fleishman, E. A., & Quaintance, M. K. Taxonomies of human performance: The description of human tasks. Orlando, FL: Academic Press.

Fleishman, E. A., & Mumford, M. D. (1988). Ability Requirements Scales. In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol II, (pp917-935). New York: Wiley.

Gael, S. (1983). Job analysis: A guide to assessing work activities. San Francisco: Jossey-Bass.

Gael, S. (1988). Interviews, questionnaires, and checklists. In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol I, (pp391-414). New York: Wiley.

Kawula, W., & Smith, A. (1975). Generic Skills. Training Research and Development Station, Department of Manpower and Immigration. Prince Albert, Saskatchewan, Canada.

Levine, E. L, Ash, R. A., Hall, H., & Sistrunk, F. (1983). Evaluation of job analysis methods by experienced job analysts. Academy of Management Journal, 26, 339-348.

Levine, E. L, Bennett, L. N., & Ash, R. A. (1979). Evaluation and use of four job analysis methods for personnel selection. Public Personnel Management, 8, 146-151.

McCormick, E. J., Jeanneret, P. R., & Mecham, R. C. (1972). A Study of job characteristics and job dimensions as based on the Position Analysis Questionnaire (PAQ). Journal of Applied Psychology, 56, 347-368.

McCormick, E. J., & Jeanneret, P. R. (1988). Position Analysis Questionnaire (PAQ). In S. Gael (Ed.), The job analysis handbook for business, industry, and government, Vol II, (pp825-842). New York: Wiley.

APPENDIX D

Current Service Fundamental Skills Programs

Appendix D: CURRENT SERVICE FUNDAMENTAL SKILLS PROGRAMS

Service education and training programs which can be broadly classified as providing instruction in fundamental skills seem to be in a state of constant change. Thus, a considerable amount of the information for the descriptions contained herein was provided by personal communication with government program managers for the various courses, and technical personnel who participated in their development. For their patience with our questions and input, we would like to thank the following individuals: Mr. Bill Hayes (Navy-NETPMSA), Dr.'s Meryl Baker and Nick Van Nader (Navy-NPPRC), Lt. Col. Ron Tarr (OSD-TPDC), Mr. Mike Perez (Army-ACES), Dr. Robert K. Branson (Florida State University), and Dr. Beatrice Farr (Army-ARI).

Navy's Job-Oriented Basic Skills (JOBS)

In 1978, the Navy implemented the Job-Oriented Basic Skills (JOBS) program to address the widely predicted shortfall of high quality recruits. The JOBS program provided low aptitude recruits with Job-Oriented basic or prerequisites skills training needed to complete selected "A" schools (basic technical schools) or BE/E schools (preparatory schools in basic electrical or electronics skills) and to perform to standards in the fleet. JOBS prerequisite skills training covers basic skills such as mathematics and reading which are taught in four to eight week courses at designated JOBS schools.

Initially, JOBS training covered four training areas (strands); propulsion engineering (PE), Operations (OPS), administration/clerical, and electricity/electronics (E/E). A detailed description of curriculum development procedures for the initial JOBS program appears in Harding, Mogford, Melching, and Showel (1981). The original four strands have been redefined/expanded to seven. The seven strands are:

1. Administrative;
2. Airframe Mechanical;
3. Electrical;
4. Electronics;
5. Navigation;
6. Operations; and
7. Propulsion.

The Administrative, Airframe Mechanical, Navigations, Operations and Propulsion strands are taught exclusively in "A" schools. The Electrical and Electronics strands are taught in both "A" schools and BE/E schools.

The initial identification of the enabling skills required to assist the low aptitude recruits selected for the program was based upon a "concepts oriented" methodology

developed by the Naval Personnel Research and Development Center (NPRDC). This methodology focused upon identifying those skills which would enable students to understand the instruction and concepts of "A" school instruction (conversation with M. Baker, 1991). A written statement was tailored for the various courses covered by the initial 4 JOBS strands and a series of questions were developed based upon the statements. The answers were evaluated using a complex algorithm which expressed understanding in mathematical terms.

The methodology was tested on a series of "A" school qualified recruits and on a series of recruits selected for the JOBS program. The results of this test were that the "A" school qualified Cohort "understood" and the JOBS program Cohort did not understand the concepts. The differences in the responses of the two Cohort groups were analyzed and those enabling skills possessed by the "A" school qualified Cohort and not present in the JOBS Cohort were identified. Repeated trials of this methodology finalized the list of required enabling skills that the JOBS curriculum was required to enhance.

Personnel are selected for JOBS training on the basics of their ASVAB Composite score. The ASVAB tests that make up the composites and the cutoff scores for admittance to specific "A" schools have varied over time. The ASVAB score requirements for the selection of JOBS candidates have also varied. Scores for those selected for JOBS are below the normal cutoff levels for the schools and have been limited to a 30-point range.

Baker and Hamovitch (1983) reported that despite the high percentage of JOBS students in mental category IV, 79 percent graduated from the "A" or BE/E school programs to which the were assigned. Their overall attrition rate was only 11 percent higher than the other students. The JOBS students were found to perform well in the fleet after "A" or BE/E school with an attrition rate 8 percent lower than non-JOBS students. A cost-benefit analysis conducted by Lurie (1983) conducted that the JOBS program (initial four strands) was cost effective. It was also found to promote greater minority participation in "A" school training. Almost 60 percent of the JOBS students were members of minority groups, contrasted to 20 percent of non-JOBS students.

Since the Baker and Hamovitch investigation, JOBS participation has increased and as stated previously, the number of strands have been expanded to seven. In 1989 the NPRDC conducted a study to evaluate the overall program effectiveness (Main, Seymour, & Morris, 1989). The characteristics and attrition rates of students participating in the JOBS programs and of non-JOBS students attending the same schools were examined and compared for the same time period. Data were analyzed for nearly 7,000 JOBS and over 200,000 non-JOBS students. Minority participation in "A" schools was found to be 30 percent higher for JOBS than for non-JOBS students. AFQT scores were found to be about 50 percent lower for the JOBS students. JOBS schools graduated 93 percent of their students. JOBS students attending "A" school graduated at a 83 percent rate and those attending BE/E schools graduated at a 74

percent rate. Attrition rates from "A" and BE/E schools averaged 7 percent higher for JOBS than for non-JOBS students. Fleet attrition of "A" school graduates were found to be 8 percent higher for JOBS than non-JOBS students. This finding was in sharp contrast to Baker and Hamovitch (1983) reported fleet attrition of 8 percent lower for JOBS students.

Despite a significant expansion in the JOBS program, a high level of success has been achieved and maintained over a sustained period. It has increased minority involvement, increased "A" and BE/E school completion and fleet service. However, a full assessment of the JOBS program has yet to be accomplished. Further research is required to directly link the effects of JOBS training to "A" school performance. Also, in ratings with excessive academic attrition, similar types of prerequisite skill training may be needed for non-JOBS ASVAB qualified students.

Navy's Fundamental Applied Skills Training (FAST)

The Fast program has been developed to improve the reading (vocabulary and comprehension) and study skills of Navy recruits who score below 42 on the Verbal Evaluation (VE) portion of the Armed Services Vocational Aptitude Battery (ASVAB). The program is implemented at the Navy's 3 Recruit Training Centers (Orlando, San Diego and Great Lakes).

FAST is delivered to selected recruits after basic military training, prior to Recruit training. It is designed to be a 3 week course, however some recruits require a longer period in the program. The program is standardized at all three training centers. The reading instruction is conducted by contractors to the Navy and the study skills instruction is conducted by Navy Training Center personnel. The content of both segments of instruction include both general and job specific subject matter. The instructional mode is classroom lecture with practical work, evaluation, and feedback.

The program normally includes approximately 3% of Navy recruits. The programs objective is to improve the participants potential to successfully complete Recruit training; all participants complete the program. The students are evaluated using a pre-test and post-test procedure to measure the effectiveness of the training and to determine when adequate skill improvement has been achieved.

Naval On Board Training (OBT) Program

The Navy's On Board Training Program is primarily a skills refresher and enhancement program for sailors in fleet assignments. Interactive courseware dominates the delivery modes for most of the numerous training packages. Computer based training (CBT) is the leading media followed by a large inventory of computer aided instruction (CAI). The program also provides on board training by subject matter experts for some skills; i.e., On Board Maintenance Training (OMT) delivered by Naval Ship Systems Engineering Station (NAVSSES). The subject

matter experts deliver the courses abroad ship for a prescribed fee. The inventory of available skills training covers the vast majority of fleet required skills. The Naval Education and Training Program Management and Support Activity publishes a quarterly OBT Clearinghouse Newsletter which keeps the fleet informed of new courses and other new events associated with the program.

Although the OBT program is primarily a skills enhancement program, the inventory of available courses does include two CBT programs which could be categorized as "fundamental skills". Recent additions to the OBT inventory include a basic math course and a basic reading course. The two courses are not job related. They are designed to improve the basic math and reading skills of sailors in the fleet. Individual enrollment in the program is primarily voluntary; however, they can be commander referred.

Army's Read-to-Lead Program

This is a new Army program which is currently being distributed to the field. Read-to-Lead is a workplace literacy program which provides training in skill applications used to perform job tasks. The emphasis in a workplace literacy program is on locating information for immediate use and problem solving rather than on memorizing content for future reference. Read-to-Lead teaches higher-order reading skills in the context of Army regulations, field and technical manuals. By using materials soldiers read daily, there should be high transfer of learning to job performance.

Those possessing reading skills at the eight grade level and higher on the Test of Adult Basic Education are candidates for the program. Soldiers with lower skills may need a more structured learning approach. The program consists of eight exercise modules for use with The Read-to-Lead Resource Book, Instructor's Guide, and Soldier's Guide. The resource book is an anthology of readings from Army manuals, doctrinal prose, and relevant news articles.

Read-to-Lead can be used in the classroom, in small groups, or individually. Its primary users are expected to be career NCOs who are unable to attend formal classes and will work on their own to improve reading skills. Unlike other Army Continuing Education System programs in which soldiers enroll, complete school work, and post-test within a short period of time, Read-to-Lead is designed as a continuing education program.

Army's Job Skills Education Program (JSEP)

JSEP was originally developed for the Army Continuing Education System (ACES) by Florida State University and Ford Aerospace Corporation under the direction of the Army Research Institute. It is designed to assist individuals to improve the academic skills required to learn a specific occupation and to be better

prepared for employment or subsequent education and training. It currently exist in its original Army version and in a civilian version based on the Army version.

The Army version is an individualized, computer-based instructional system designed to improve soldier's abilities to learn their military jobs, or MOS. This version operates on both the PLATO and MicroTICCIT computer systems. It consists of about 300 lessons addressing about 200 general academic skills identified by an extensive analysis (described in the main body of this paper) of 94 Army MOS in which about 85 percent of all enlisted soldiers are employed. There are three types of lessons in JSEP: (1) verbal lessons that teach reading and writing skills; (2) quantitative lessons that teach mathematical skills; and (3) learner strategies lessons to improve students' abilities to learn and benefit from instruction. Students are guided through lessons selected for them ("Prescriptions") by a computer program that keeps track of their attendance and performance data provides progress reports for students, instructors, and administrators.

Approximately 20 Army posts now use JSEP which is the largest computer-based basic-skills program ever developed for adults. Soldiers may volunteer for the program, or be referred due to being diagnosed as deficient in the academic skills needed on the job. The JSEP curriculum includes 180 short diagnostic review lessons. Soldiers first take the particular diagnostic lesson which have been prescribed for their MOS. They then take tests on the lessons, and depending on the outcome of the tests, they branch to more extensive tutorial remedial lessons or move on to different lessons.

The civilian version of JSEP was developed under an interagency agreement jointly signed by the Departments of Education, Labor, and Defense to transfer technology developed by the government to civilian sectors. JSEP is the first major computer-based instructional program to be revised for civilian use. The civilian version takes advantage of similarities between Army and civilian jobs. In preparing the civilian version, the original military analyses of 94 MOS were used to devise JSEP instruction for about 20 civilian occupations taken from the Dictionary of Occupational Titles. About 90 percent of the Army materials were found to be usable in the civilian version. The civilian version operates on the Micro TICCIT computer system, which networks individuals workstations with a central host system.

Recent evaluations have found the JSEP to be instructionally effective and well accepted by the students (Fletcher, Bosco, Wienclaw, Ashcraft, and Boycan, 1991). However, there were criticisms expressed which should be of interest to other organizations, such as the Air Force, who are considering using the technology. These criticisms can be summarized as follows: (a) additional "de-greening" is needed, (b) JSEP computer systems are relatively expensive and incompatible with commonly available computer systems, and (c) more technical support is needed for both JSEP courseware and software.

Army's Basic Skills Education Program (BSEP)

BSEP I and II are two of the Army's on-duty educational programs designed to develop educational competencies required for job performance, skill qualification and career growth (Army Reg. 621-5, 1 May 1989). Other Army programs with this objective include JSEP and English-as-a-Second Language (ESL). The programs are monitored by Education Service Officers (ESOs) and instruction is provided by contract teachers. BSEP I provides basic academic competencies necessary to complete initial entry training (IET) successfully. Soldiers who have a recognized deficiency in IET are placed into the program by their commands. BSEP I testing and training is then monitored by the local ESOs. The Army Training and Doctrine Command (TRADOC) establishes enrollment criteria.

BSEP II provides job related basic skills necessary to enhance job proficiency. It is non-standardized and provided by contract training at the various installations. This phase of BSEP provides instruction in the reading, writing, speaking, listening, and computing skills needed to perform MOS required duties at skill levels one and two. Commanders refer soldiers to the program who have a recognized education deficiency; or do not meet reenlistment requirements; or have a general technical (GT) score of less than 100. The ESO administers the Test of Adult Basic Education (TABE) Level D. Soldiers not achieving the following TABE scale scores are enrolled in the program: Reading 582, Math 588, and Language 581.

BSEP II had been further subdivided into II-A and II-B at many installations. BSEP II-A is intended to provide foundation skills equivalent to school grades 5 through 9. BSEP II-B is intended to provided "refresher" instructions for grade level 10 through 12.

Partly in response to concerns regarding the lack of BSEP standardization and diverse curricular at the various installations, the Army is currently developing a standardized basic skills curriculum. Big Bend Community College is under contract to revise several courses now being offered in the various MACOMS into one standardized course using previously developed materials. Of the 41 standard lessons to be produced, 23 will be devoted to mathematics, 11 to reading, and 7 to writing. The college has contracted with Educational Testing Service to construct and validate the diagnostic/mastery tests for the lessons. Like BSEP, this new course will also be conventional in instructional methods, although it is scheduled to employ an automated student management system.

Army's English-as-a-Second Language (ESL) Program

ESL provides second language soldiers with english language skills needed to perform their duties. Like BSEP II, these courses are offered sat the various installations and enrollees are commander referred. Those soldiers who have difficulty in understanding or speaking English (referrals) are tested by the ESO

using the English Comprehension Language Test (ECLT). Soldiers scoring below 70 (enlisted) and 90 (officers) respectively are enrolled in ESL.

REFERENCES

Baker, M.S., & Hamovitch, M. (1983). Job-Oriented Basic Skills (JOBS) Training Program: An Evaluation. (NPRDC TR 83-5). San Diego: Navy Personnel Research and Development Center (AD-A124 150)

Fletcher, J.D., Bosco, J., Wienclaw, R., Ashcraft, J., & Boycan, G. (1991). Assessment of DoD Job Skill Enhancement Programs. (IDA Document D-939). Institute for DefenseAnalysis. Alexandria, Virginia.

Harding , S.R., Mogford, B., Melching, W.H. & Showel, M. (1981). The Development of four job-oriented basic skills program (NPRDC TR 81-24). San Diego: Navy Personnel Research and Development Center. (AD-A106370).

Main, R.E., Seymour, G.E. & Morris, B.A. (1989). Job-oriented basic skills (JOBS) training: a long-term evaluation (NPRDC TR 90-2). San Diego: Navy Personnel Research and Development Center.

APPENDIX E

Fundamental Skills Workshop Documentation

Appendix E: FUNDAMENTAL SKILLS WORKSHOP DOCUMENTATION

This document summarizes discussions and findings from the Fundamental Skills Workshop, held in San Antonio,Texas, 11 and 12 July 1991. The conference was sponsored by the Human Resources Directorate of the Armstrong Laboratory, Brooks AFB, Texas.

The content for this report represents a summary of our recordings and notes. This is not a verbatim transcription but provides an accurate documentation of workshop proceedings.

The participants in this workshop are listed below:

Consultants

Dr. Steven Ceci, Cornell University
Dr. Steven Reder, Northwest Regional Educational Laboratory
Dr. Tom Sticht, Applied Behavioral & Cognitive Sciences, Inc.

Air Force Armstrong Laboratory

Capt. Keric Chin
Dr. Juanita Firestone (University of Texas)
Dr. Ted Lamb
Dr. Hendrick Ruck
Maj. Bill Wimpee
Mr. Tony Villanueva

Hay Systems Inc.

Dr. Louis Armijo
Dr. David Payne

Proceedings

Session I 11 July 91

The workshop was opened by Dr. Payne (Workshop Moderator) of HSI at 8:00 AM. Participants were introduced and administrative procedures were clarified.

Dr. Payne provided a brief overview and synopsis of reviewer inputs/goals for the workshop. He then introduced Dr. Hendrick Ruck of the Armstrong Laboratory.

Dr. Ruck provided an overview of previous work done in the area of fundamental skills, the reason for the workshop, and the hoped for outcomes. He also made known the Air Forces' concerns for the potential lack of fundamental skills in future recruits.

The military has been connected with the question of basic skills since World War II. Research in basic and fundamental skills has been conducted by the military research labs for a number of years. Some of the more recent work conducted by Armstrong Laboratory in this area are:

- Work of Dr. Sherry Gott in Basic Skills
- Development of intelligent tutors
- Fundamental Skills Needs Analysis

Currently the Air Force is able to recruit "from the top". A high school diploma is required for enlistment in the Air Force with a minimum component scores on the Armed Forces Vocational Aptitude Test Battery (ASVAB).

Yet the Air Force is concerned about the potential lack of fundamental skills of future recruits. Some of the reasons for concern are:

- Test score decline-SAT,ACT
- Continuing problems with public education (what is a high school diploma worth)
- Changes in demographics

Previous works were essentially atheoretical approaches to solving immediate problems. There is a need to be able to define fundamental skills and develop a framework for future research.

Dr. Ruck then introduced Dr. Lamb who presented additional program background information.

Dr. Lamb - The Air Force is concerned because of changes in the potential recruit pool. The education taking place does not prepare people so that the A.F. can develop them into the avionics technicians, crew chiefs or security police. The technical requirements in the Air Force are increasing while the education level appears to be decreasing. In 3/4ths of the career fields some math and science background is required. It is estimated that in 10 years or so there is going to be a substantial increase in requirements for people with high aptitudes. The Air Force sees itself in competition with academia and industry who are competing for the high aptitude individuals. We predict the high-school drop out rate is going to increase, in San Antonio, for example the drop out rate is 50% or better for minority males. Also fewer people are able to speak a second language.

For 18-22 year olds in the male population, the decrease begins to correct itself around the year 2000, but when you look at the demographics you will also see that the growth rates are dramatically different; blacks, whites, and hispanic ratios are very different in the Air Force recruit pool. Hispanics are growing at almost four times the rate of whites. What concerns the Air Force is that groups with the highest growth rate, also have the highest high-school drop out rate. This concerns the Air Force because a high-school degree is a prerequisite. A second concern is; what does that degree mean? There is also a great concern for the rapid decline in the SAT, and ACT scores. The fundamental skills project was started in the hopes that we could make some changes:

- We are attempting to define and frame the problem.
- Develop national needs assessment to determine what kind of fundamental skills are needed?
- Define the Air Force specific requirements in fundamental skills. In AF specialties what skills are needed?
- Develop an instrument to measure the basic skills needed, that is able to determine:

  1) What skills are required in the specialty.
  2) What the person brings to the specialty.

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Dr. Payne - I see some common threads in these two presentations which can provide helpful insight to us concerning where the Air Force is going with the FS program. This also relates to one of the issues surfaced in your (expert consultants) review of the HSI paper. These issues were:

- What is the "big picture" for the Air Force concerning their FS program? What are their goals? How does this project relate to similar projects?
- The sociological and anthropological view points have not been well conceptualized in the paper; these concepts can give us insights to socialization and communication skills.
- There may not be a skills gap. Evidence both ways, the report prepared prior for this conference presents a one sided picture.

Dr. Payne then asked for opening comments, issues for discussion, etc. from the consultants, starting with Dr Sticht.

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Dr. Sticht discussed the Secretary's Commission on Achieving Necessary Skills, (SCANS), and how the work of this commission relates to this effort.

The Commission was formed in order to identify the skills and knowledge that should be put into an examination to test what will be necessary to be successful in the world of work. Unfortunately the skills identified in SCANS are not being identified in typical job task analysis. The SCANS skills are identified for a world of work that does not exist now, but for jobs of the future.

George Bush, supports the SCANS' findings. SCANS identifies the skills required for work in America, [See Attached (1) SCANS slides presented by Dr. Sticht.] Scans is trying to implement a Competency Based Degree, the idea that you get promoted on tested ability, not simply that you have been in school.

One of the things that you might have to do is to characterize the Air Force as to where it is today in terms of a high performance continuum. How you will move to the 21st century high performance world of work. How will you characterize the fundamental skill requirements of the new AF of the 21st century?

This is not possible using traditional job task analysis, you have to build a theoretical model. The SCANS research has been driven by such a model. The skills that are identified are for the bulk, that is 95% of American businesses.

However, without moving to a high performance workplace, there will be no skills gap. As summarized by Bill Brock, Former Secretary of Labor, "The good news is there is no skills gap. The bad news is that there is no skills gap."

SCANS was made up of five task forces, focusing on skills necessary for a person at age 16 to be able to enter into a high performance workforce.

SCANS concluded that you cannot pull basic skills out of context. They don't exist out of context, so they struggled to contextualize the skills to describe cross cutting broad bodies of knowledge.

There is no technical methodology for the SCANS research. It is a political activity, subject to socioeconomic forces of the times. " The three part foundations " was labeled as such because it was acceptable politically.

The goal was to come up with a five skill system certificate of initial mastery. SCANS will have a broad impact telling schools and industry how to do their job. The national test will not just be paper and pencil. There will be a dissemination and input strategy.

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Dr. Ceci - I will attempt to synthesize the relationship between basic skills and advanced types of thinking.

Previous presumptions were:

1. There is a bottom up process. You train people with the component skills and they put these together and "wala" that gives you the more advanced types of cognition.

2. The role of transfer, training someone to think in one context and they should be able to generalize or transfer that training to other similar components of training or cross training.

These presumptions are now highly suspect.

I have conducted research on the influence of context, in determining the proficiency of performance. Looking at people in everyday settings and examining how they solve important environmental challenges in their lives, one is often struck by the sophistication with which they can do these things. But when you shift them a little bit out of that setting into another similar setting, your often amazed at how foolish they act. The setting (context) in which we work is very important in assessing the way we learn.

He then talked about an experiment with Race track simulation - a model of horse racing where experienced betters did well. On a stock market simulation, these same subjects did very poorly. When he gave them a hint about how market simulation is related (contextually) to horse racing, their performance improved right away.

What we in cognitive science see today is that most people have a set of environmental tools to meet important environmental challenges, things they confront in their lives. If you teach them any other way, they may learn it for the moment, but they forget it soon after and they certainly do not generalize it beyond what/how they have learned it.

In cognitive science we are seeing a recognition that these things appear in context. Sometimes what you find is that they appear in multiple context throughout the course of development or in extensive training. When that happens, and only when that happens, you may start making connections. The same sort of things I do over here I do over there. When it becomes really general, or generally skilled, it can be deployed in the service of solving all kinds of problems that resemble the one they were trained on.

Does this mean you have to train people in every imaginable context that you can think of? To do it any other way is not likely to have payoffs.

To create the "skill" to transfer, one possibility is to extend training, making it longer and more expensive. If you want to train someone to be able to do two

things that are really different, don't train them on some general fundamental skill, train them to do this and then train them to do that.

How do you build in some kind of training, some kind of cognitive "stuff", so that a person could come to the task with a certain probability of actually solve the task. This is going to be our long term training problem which the basic skills problem will be couched within.

How did we do it in the Gulf? With contractors! How do we do it now? We call in tech specialist from the company.

Fewer people are going to have to learn how to service more different things. I don't prefer this, I would organize the work into the specific training programs, not a general overall knowledge; specifically, this is how you do this radar system, and this is how you do that one.

"The times you get transfer from one context to another is the exception not the rule."

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Dr. Reder - (Presented poster from New Yorker magazine demonstrating ethnocentric perspective.)

A conceptual model of skills could suffer the same disciplinary bias "view of the world from culture" (culture is a residual concept). Working within each framework will give different perspective and different issues. I will attempt to apply the R&D agenda that can be brought from working with children and early education to adult training.

What is it about doing a task in one way that makes it similar/different from doing another task? Need to develop a theory of domains.

There are three types of knowledge or areas to break it down:

1. School knowledge
2. Technical knowledge
3. Functional knowledge

We may need alternative training systems for getting task continuity.

New Systems for training people are needed to combine their expertise. Look at communication and structure of command within teams. Skills that will allow new social structure.

Clues from research with children give us a theoretical base from which to develop potentially new kinds of training that will incorporate some of these characteristics.

- Zone of Proximal Development - Imagine taking a group working together on a task and comparing the performance of one person in the group with the performance of an individual working alone doing the same task.

- Hart Project- cognitive apprenticeship training in elementary schools- (Zone of Proximal Development) is actually trying to systematize a training environment seen as a social setting to individual cognitive development.

We have to examine new kinds of training situations in relation to the social environments in which tasks are being accomplished.

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Open group discussion about how the Air Force trains individuals, not groups.

Participants brought forth the following points.

- Teamwork not being trained.
- 98% go to tech school.
- Goals - selection process a fine screen.
- Tech schools get people ready to learn... They come out knowing terminology, theory, little hands on experience.
- The point is, You really gain your technical expertise on the Job...

The primary way that we do OJT is the apprentice. The boss sharing knowledge and skill with the new person.

- AF expects a lot of individual initiative....We don't do many things officially that require teamwork.
- All training is viewed as individual exercises.
- Social Technical- Rivet Work Force proposes generalists. But in order to get results, specialization is not so bad. We only have these people for 4 years and we feel we have reached a saturation point of how much information we can cram into a person .

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Lunch Break

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Dr. Payne, using the diagram at Attachment 2, initiated a discussion which focused on where fundamental skills might be placed on a continuum from aptitudes and skills measured by the ASVAB, to task performance skills on the job.

Group comments included:

- Remember people are coming in with skills, not blank slates. Presumably, some of these core skills are relevant to career field.
- Fundamental skills may be viewed as prerequisite to the career field.
- Dr. Sticht stated that the ASVAB is not measuring skill but measuring knowledge.

Dr. Sticht: Given the cost of training, I do not know if we should be so concerned with fixing people; why don't we study the environment we are putting these people in? Redesigning environments "ask not what is inside your head but what your head is inside of".

- How smart do you make the person, or how smart do you make the weapon system.

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Dr. Payne: Let's consider the questions you were asked to discuss here at the workshop (Attachment 3). I would like each of you [consultants] to address the first question, in turn, for the group. First, Fundamental Skills- How do you think they should be defined?

Dr. Sticht: Fundamental skills should be defined according to the context in which one wants to use the definition. The ASVAB is not measuring skill, it is measuring knowledge. The way you teach knowledge is very different from the way you teach skill. There is a huge difference in how you develop knowledge and how you develop skill. You can't come up with a definition without knowing the use/environment.

Dr. Armijo: You might have to have core skills before you can have fundamental skills . Core skills are those kinds of things we would expect, demand, or require by regulation that all people have when they walk into the service. Fundamental skills would be those skills which cover a broad range of career fields, lets say all electronics and mechanical, but not job specific task oriented skills. Have fundamental skills built on core skills. Core skills are those which everyone will have by default, they are not our problem. Fundamental skills are tied to a job.

Group Discussion:

- Prove that it is trainable. A skill, by definition, must be trainable.
- ASVAB is based on a mild analysis of the skill requirements of the job.

Dr. Payne asked Dr. Sticht- Do you feel there is a concept of fundamental skills, or one worth while?

Dr. Sticht, "I had said that fundamental skills should be defined according to the context in which one wants to use the definition, I don't think the context of use have been well enough specified, to come up with some generic list of fundamental skills. I say this for the same reason that Sherry Gott called what she ended up with "basic skills." Review SCANS as possibility for getting thinking in line, a prototype for the Air Force approach.

Dr. Ruck, Lets come up to a number of opportunities for looking at basic skills. If skills are to be thought of as basic in the Air Force, they can't be job specific.

Dr. Sticht - Developing a higher level competence. How do you remediate how to learn?

Dr. Ceci spoke on learning how to learn, gambler example; shoppers with no price per unit costs - women can do mental math, but that is because they have learned to do it in that context. If you want a person to be good at measuring in the context of repairing a radar system, have them learn measurement in that context and not in some abstract context, because from what we know it may not transfer very well. SCANS endorses the fact that people should be taught in context.

Nobody runs all of the training in the Air Force, everyone manages a piece of it. We need to get some consensus on what basic skills are. We can't just say it is to hard, we need to come up to a number of opportunities for listing basic skills, some old, some new, let's give Doctor Lamb a list so he can say we are going to look at these, he has a list of those babies. There related certainly to job requirements and they probably should be trained in relation to the job context, but if they are going to be thought of as basic in the Air Force they have to not be in a job. If they are specific job skill requirements, they belong in technical training.

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Dr. Reder (On defining fundamental skills.)
There has been a long history of attempts to have broad range competency based assessment schemes. As far as I can tell they all have the same basic problem which is none of them have much empirical validation in terms of people actually being demonstrated as to have these types of competencies in anything other than very task specific ways. APL developed in Texas in early 70's, same problem.

Another approach- Think of defining fundamental skills as enabling skills. Define a fundamental skill as something that would optimize people's ability to learn on the job. Research would be needed to figure out why some people learn better in an apprenticeship position. Look at the entire training process and ID those skills needed.

There is an awful lot that happens in the Air Force, that you do not get formally trained for, and it gets transmitted informally. One of the interesting things to me

would be to figure out a method of tapping the informal education and training that people get. Through participant observation or ethnographic methods, this is where you find out those critical skills, "We have to be there to see it."

Mention of an office environment project called "Learning the Ropes."

Define again fundamental skills- map empirically what skills are. Try to look at alignment between knowledge and experience that is used in the work environment.

Group Discussion:

Dr. Sticht - Doing training is different than talking about doing training.

The APL did not take inputs and send them back out to the world.

Dr. Lamb - Review theoretical orientations. One is JSEP derived primarily through task analysis approach.

Dr. Ceci - It must be at the bottom to be basic. Most can be almost at the physiological level.

Dr. Sticht - The whole is greater than the sum of it's parts.

Dr. Ceci - The whole is different from the sum of it's parts.

Dr. Payne - Are we talking about a sociological, anthropological, or cultural definition of fundamental skills?

Dr. Ceci - We are talking about situated cognition

Dr. Reder - Context has both internal and external components, to an individual, cognition is not solely the attribute of an individual organism, but by being socially situated it is a social phenomenon.

Dr. Lamb - Is the criteria situated?

Dr. Ceci - Not fundamental skills, rather talk about competencies.

Dr. Sticht - Basic adaptive processes don't have a concept approach. Make explicit that you don't have many foundation skills.

Dr. Lamb - We want to come up with a definition, need something better in the actual world of work. In the Air Force people do things in groups. They are not trained in groups however.

Dr. Payne - We find theories or viewpoints in all the fields. Socialization is also a goal. The ethnic culture into the blue culture.

Dr. Payne then closed the first day session by presenting a slide which listed a number of criteria for evaluating definitions of fundamental skills (Attachment 5). He asked the consultants to review the criteria and to be prepared to comment on them during the next days session.
End of Session I

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Session II - 12 July 91

Dr. Payne opened the meeting at 8 A.M. by summing up the different view points of the consultants expressed in Session 1 on how to go about defining fundamental skills.

- Dr. Sticht claimed that it was probable not of full utility to go in search of a list, and then go in search of an application . Fundamental skills really do not exist independent of the context in which they need be displayed or required.

He also put a proposed approach on the table, SCANS, in terms of identifying competencies for which skills would apply to varying degrees. These skills could then be identified and learned in context with the performance of these behaviors or competencies. He suggested that perhaps this same approach could be used if we were to replace the different areas looked at by the SCANS Commission with an career field or specialty.

- Dr. Reder stated that fundamental skills are, in his mind, enabling skills or prerequisite to follow on success in training. Perhaps more importantly on the job, these fundamental skills are a prerequisite or an enabling type of skill.

- Dr. Ceci takes a more basic approach to fundamental skills. From the view of a cognitive psychologist such as information processing skill, encoding decoding, and so forth. He added that if you were to break down reading as a skill into all the different sub-blocks, you could really get down into the weeds. The sum of the parts is not likely equal to the whole. Your way out is context, in terms of utility and application for the Air Force.

Dr. Payne - Lets return to what is meant about fundamental skills in context? What we are talking about when we say fundamental skills must be considered in context. Do we have to identify them on the job, train them on the job? What are we talking about in terms of implications for final report and recommendations?

Dr. Reder - There are a lot of different approaches that can be taken; for example, Geards formulated context as a set of choices facing an individual. I suggested

yesterday we develop a mapping context, a systematic approach independent of job classification. In ethnographic study how the participants understand the job world.

Experts approach the situation differently from novices. The new duty assignment is a context switch, what someone has learned elsewhere being applied to the new situation. Try to lower the extent to which the context switches are disruptive.

The context can have many social dimensions, physical, psychological dimensions. From a sociological background, context to me means roles, norms, statuses, values and beliefs.

Thinking about the contextual components of a task, context switches are important. When we think about domains, we are talking about some classification of context; avionics, flight crews, different training streams.

In a study of a fishing village in Alaska, there were four domains: fishing, church, company store and public setting. Each of these domains had it's own structure of knowledge that people had, sets of rules and expectations, and differently structured processes of socialization or informal learning. the Air Force might find the same thing if they got down to that type of domain level.

Dr. Firestone - I think what we see in the Air Force is that individuals don't perceive the context of education fitting into the context of work. They perceive them as totally separate, and so if you train them on the job it makes more sense, they can transfer that information.

Dr. Sticht - A context keeps everything whole and coherent from an abstract definitional sense. One of the things I find useful is to always have a problem I'm trying to solve. For instance the Army, is a context. I wrote up a thing called "Literacy and Human Resource Development at Work; Investing in Education of Adults to Improve the Educability of Children" and in that I tried to lay out the point that if you are going to do education of adults in a workplace setting you have to consider the context. The organization is most effective when it can utilize the widest range of available pool of workers. If I can only take the top 30% and another organization can take the top 50% I am less effective. How can I improve my recruitment function?

Thinking of context in terms of an individual, I have a book called "Cast Off Youth, Policy and Training Methods from the Military Experience", it lays out a lot of functional context educational concepts, and it explicitly talks about the internal context of the person. From the persons point of view, that is the context they are experiencing. Whatever they have in their head translates the world into something for them. They negotiate the world from their internal context. As a instructional designer I have to look at that and wonder what that persons internal

context is like. How do they navigate the world. Why am I training them? Ycu want to do something to this person so they can work in a future context.

You have to consider the organizational needs and also the social, cultural, and historical time that your in.

Dr. Lamb - Within the Air Force if we are going to have anything to do with fundamental skills, competencies, training or whatever we might call these things, it should be somehow anchored within what is actually taking place on the job.

Dr. Sticht- The first thing is what is your organizational effectiveness and development goal. You need ways to indicate organizational effectiveness goal.

Dr. Lamb - The measure of organizational effectiveness may be part of the context and it may change over time.

Dr. Reder - Is the ability to perceive and switch context a skill that should be taught? The question for the Air Force is how important is it to determine context? The knowledge in the mind reorganizes as it encounters certain contexts. You need to know what others know along with what you know.

Dr. Payne - One of our criteria for the fundamental skills requires that there be some indication or link to the job performed. In other words, the skill is important because it is required for performance on the job. You have to show that link. What list of skills from your perspective could we give to the Air Force?

Dr. Sticht:

1. It depends on what you want to do.
2. You don't have any well defined sets of problems.
3. You did not say you have too many people not passing tests or being promoted.

You might just say that you want to make people more broadly effective and efficient in their work place, and in future work places. If you said the latter, then I would recommend something like the SCANS approach, because it is not the ASVAB, it is dealing with much more complex sets of activities or tasks, and it is politically viable at the present time.

If your goal is to put in place a broad training program that would help people to acquire higher and higher levels of broader and broader skills to make them more generally useful, then I think that is the sort of thing needed. At the same time it allows you to take it way back down in generality and scope, imbed it in school related activities, and incorporate it into artificial intelligence programs to go into the schools. To help cure the Air Force future problem by building a new generation of people who's skills are going to be more highly developed.

Dr. Reder - Things that will be driving the personnel changes are key factors. What implications do those have on how we organize training.

Dr. Payne- Teaching others will become an important fundamental skill.
You need to know what others know, using the knowledge and skills that others have, you know how to form and manage a group.

Dr. Sticht - There are parallels we can draw between the high performance business world, and the high performance military of the coming ages. The social historical contexts have changed, and now the organization will have to change. You will need more training in smaller groups. Problem for the military is that we only have these guys for four years.

Dr. Ruck - What do I need to change in my training system and do I need a separate base of skills curriculum for the different cultures?

Dr. Sticht - You need to consider different learning styles. Multicultural survival skills. Consider constraints on "functional context training."

Dr. Ruck - Is this to be only for first Termers? If we start talking about basic skills beyond the first term, we will definitely be met with animosity.

Dr. Ceci - What could we have ready for the Air Force at the turn of the century, that is when we would want the technology available. There is no immediate need, there is no perceived need by our leadership. [its 6-2 money]

Whatever we wind up doing it has to be trainable in a short amount of time, we can not afford to make up for the education system.

How do we know if they can be trained in a short amount of time?

Dr. Armijo - It may be that we can ID skills that are useful selection criteria for the job or for the career field.

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A brief discussion of the skills criteria (Attachment 4) occurred at this point. When asked by Dr. Payne, the consultants all agreed with and endorsed the criteria for evaluating FS definitions for Air Force use.

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Dr. Payne - How do we determine a requirement for fundamental skills in the AF? (Using slide with AF classification structure - Attachment 5.)

Essentially, what we are looking at are different levels of how the system is structured in terms of personnel. We have a career field, which can be a rather broad area related jobs which are more differentiated AF specialties. Within these specialties, we have different skills by levels and different jobs related to the different specialties. AF-CODAP data is used to derive how best to assign these structured jobs to specific AFS's and also what to train.

Dr. Ruck - Within any of these specialties there are jobs, and a job may have very little overlap with another job within that specialty. For example, about 300 different specialties, each specialty has somewhere between 10 to 20 jobs. These jobs are not formally recognized. We know they exist, and this makes training very difficult.

There are not really rigorous standards in the 3,5,7,levels. Nothing to tell you the difference between these levels. Because we do not keep people who are not working out very well, they are typically more proficient and better at what they do as they gain in skill level. Those skill levels are not tied, we sort of let the guy who can get the job done do it regardless of their skill level. We never hold anyone back if they can do a skill, unless they are doing something illegal.

Dr. Payne- One point is that these jobs can be very different even though they are in the same field.

Dr. Ruck - The official policy is we put specialties together that have the exact same underlying skill and knowledge base. A lot of them get moved because that is where we need people.

Ray Crystal, who invented CODAP, said that "In peace time our specialties get broader and broader , and in War time they narrow right on down". In peace time we do not have the money to train the way we do, it is a function of training.

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Dr. Payne next discussed what Hay Systems is doing with the rest of the task, using the slides presented at Attachment 5.

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Responses to Dr. Payne's presentation:

Dr. Sticht- You will not be able to identify these skills using any traditional job task approach. What is your model of human cognition? Do you have a developmental model, after all you presume you are taking someone and trying to develop them someplace. Shouldn't that have something to do with the way you approach cognitive task analysis.

You need to have a model of the mind that you want to work with and how you are going to work with it such as: SCANS commission, long term memory, knowledge base, processing skills, knowledge in the head or out of the head.

Dr. Reder- Think of things more as skill outcomes rather than skill requirements. Look carefully at the concept of generativeness. There are some things that once you get a little of produce a whole lot of, ie. language. The ideas you can express or infinite. Very different from a list of task words found on a job.

Dr. Ceci - JSEP seems to have a core dimension of skills such as: Visual Literacy, Math, Communication, Reading, Decentering, and Social Skills.

Take these things that seem to be repeatedly involved in task analysis, cross them with a SCANS kind of thing and come up with scenarios that are in each of these areas. I am a minimalist, so I look for something that is not very elaborate. All these other things in a certain way could also be considered generative just like language.

Do not train people to read a bar graph, teach them how to make one.

Dr. Ruck - If it is required on the job, in training you may have many things that are not now required on the job, but would be in the future.

Dr. Ceci - Some of the nature or theories Tom reviewed in his book claim that generativity is involved in human interaction to begin with. So the question is not whether people can be generative, but in what kinds of situations, and with what kinds of materials? Language is an inherently generative thing, but basically everyone learns that aspect of language, how to create new sentences, normal development. Is there just one kind of generativity? I suspect it is context specific, and I do not think we have really solved that problem. We are all saying context specificity is important, but I do not feel we have established how it is important. Particularly for some of the new areas we are talking about.

Dr. Sticht - Teaching terminology vocabulary is one aspect of trying to enlarge the knowledge base used to express ideas. The other is writing and using graphic tools, the schools try to get that because if you can write down all the words and sentences you can say, then you would know how to get across ideas. You could write down anything once you learn the basics.

In terms of future research, it is really important to have highly competent people and determine what we mean by context. I can read a book at the beach, in my car, in my kitchen, wherever, my reading skills do not disappear when I am in those different contexts. On the other hand, my skill with interacting with people might be very contingent upon whether I am at the beach or in the hospital. We need to get a better feel for the boundaries of context and it's interaction with cognition. In general it seems to me to be an idea that is very prevalent today. Used

by many people, but it is not used the same, it has different meanings and ramifications.

Dr. Reder- Tom's example of the electric ship is a great example of a context for organizing one's cognition about an electric circuit.

Learning in one setting and being able to transfer those skills to another setting is related to transfer and this concept of context.

Concluding Comments:

Drs Payne and Ruck thanked the participants for a very productive meeting. Dr. Payne also requested they provide any follow-on or additional comments to him for possible inclusion in the final report.

Dr. Lamb - We have a lot of work to do, we have some additional ideas to get a handle on the methods we want to use to identify the context we are looking at.

End of Session II and the workshop at 1 PM.

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